

University: The University of Hong Kong (HKU)
Faculty: Architecture
Title of case study: Urban Ventilation Assessment and Wind Corridor Plan for Chinese Cities
<p>1. Summary of the impact (indicative maximum 100 words)</p> <p>As sustainable urban development has become more widely recognized in China over the last decade, decision makers and planners have requested scientific based evidence to support their urban planning and design. Since 2006, Dr. Ren has conducted a series of cross-disciplinary collaborative research revealing how to evaluate urban ventilation for planning purpose and develop the wind corridor plan in urban design exercise. The research has led to the development of one national guide and one technical note endorsed by the Ministry of Natural Resources of China to implement into the city master planning exercises in all Chinese cities since 2019. The research findings were noted in the WPII-Chapter 10 Asia of the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) report and three Guides issued by World Meteorological Organization (WMO).</p>
<p>2. Underpinning research (indicative maximum 500 words)</p> <p><i>Research Insights and Outputs:</i></p> <p>Wind Corridor Plan research in Ren, et al. [1] established a scientific evaluation of the background wind conditions and local wind circulation system, the calculation of ventilation volume, and the classification of potential wind dynamics and urban heat island for the development of a comprehensive wind corridor plan. These notions were further developed and implemented in the context of urban planning system in China [2] and underpin the impact detailed here, specifically:</p> <ul style="list-style-type: none"> • <u>At the local level:</u> one RGC-CRF grant and one government consulting project commissioned by the Environmental Protection Dept of the Government of Hong Kong SAR has been awarded to understand the 3-dimensional wind behaviors in urban areas of Hong Kong for air pollution control since Dr. Ren joined HKU in 2018. Hong Kong Green Building Council has published HKGBC Microclimate Guide based on Dr. Ren’s and her team’s research findings • <u>At the national level:</u> The research results have also been adopted in the National Guide namely ‘Technical specification for climatic feasibility demonstration in urban master plan (GB/T 37529-2019)’ and further developed into an Industry Technical Note namely ‘Specifications for Climatic Feasibility Demonstration – Urban Ventilation (QX/T437-2018)’ in China, which has been endorsed by the Ministry of Natural Resources of China to implement into the city master planning exercises in all Chinese cities since 2019. Over 40 Chinese cities, including Beijing, Chengdu, Wuhan, Foshan, Hong Kong and Macau has adopted and implemented this research findings. • <u>At the international level:</u> 1) the research has led to a number of practical research and government consulting projects in cities across Asia and Europe and influenced city planning exercises and climate change adaptation policy. 2) The research findings were noted noted in the WPII-Chapter 10 Asia of the Sixth Assessment Report of the

Intergovernmental Panel on Climate Change (IPCC) report and three Guides issued by World Meteorological Organization (WMO).

Big Chinese cities represent an extreme version of the compact city, and they all have achieved extraordinarily high densities by constructing tall, closely spaced buildings in a complex topographic setting. Fast urbanization in China has caused a series of urban environmental problems and challenges. The impact of the urban development has been to starve much of the population from this natural air conditioner. As the city is substantially built, the design and political challenge has been how best to re-form the city (and rehabilitate its climate) when opportunity arises.

The project team's cross-disciplinary collaboration and architectural design mindset are strongly rooted in the tradition of architecture and built-environment for the improvement of humanity. The team has explored the potential for extracting information from arcane scientific urban climate work that can be converted into guidelines that be used to modify the urban landscape and achieve desirable and quality living environment. The wind corridor plan and urban climatic application approach has been adopted worldwide. The team has gone a step further by engaging successfully with public bodies and local municipality governments to ensure that the guidelines are translated into design practice.

Key researchers:

Dr. Chao Ren is the project leader and key researcher who has developed of the National Guide and Industry Technical Note in China and been involved in urban ventilation and wind corridor related government consulting projects in mainland China, Taiwan (Kaohsiung), Singapore, The Netherlands (Arnhem) and France (Toulouse). The core teammates are Prof. Edward Ng of CUHK, Prof. Jimmy Fung of HKUST, Prof. Yuguo Li of HKU, Dr. Yuan Shi, Dr. Chao Yuan, Dr. Kevin Lau.

3. References to the research (indicative maximum of six references)

1. **Ren, C.**, Yang, R., Cheng, C., Xing, P., Fang, X., Zhang, et al., (2018). *Creating breathing cities by adopting urban ventilation assessment and wind corridor plan – The implementation in Chinese cities*. Journal of Wind Engineering and Industrial Aerodynamics, (2018). 182, 170-188. <https://doi.org/10.1016/j.jweia.2018.09.023>
2. **Ren, C.**, 2016, *Urban Ventilation Assessment and Wind Corridor Plan: Creating Breathing Cities* (城市風環境評估與風道規劃-打造呼吸城市), Beijing: China Architecture and Building Press, 300 pgs, ISBN: 978-7-112-20012-2, published in Dec. 2016 in Chinese. [3rd prize of the first Architectural Technology Book Award in 2018, the China Architecture & Building Press]
3. Ng, E., & **Ren, C.** (Ed.), 2015, *The Urban Climatic Map: A Methodology for Sustainable Urban Planning*, London: UK, Routledge, Taylor & Francis Group, 528pgs, ISBN-13: 978-1849713764, ISBN-10: 1849713766
4. Yin, S., **Ren, C.**, Zhang, X., Hidalgo, J., Schoetter, R., Kwok, Y. T., & Lau, K. K.-L. (2022). *Potential of Synthesizing Climatopes and Local Climate Zones for Urban Climatic Planning Recommendations: A Case Study in Toulouse, France*. Cybergeog: European Journal of Geography. <https://doi.org/10.4000/cybergeog.39417>
5. **Ren, C.**, Lau, K. L., Yiu, K. P., & Ng, E. (2013). *The application of urban climatic mapping to the urban planning of high-density cities: The case of Kaohsiung, Taiwan*. *Cities*, 31, 1-16.
6. **Ren, C.**, Spit, T., Lenzholzer, S., Yim, H. L. S., van Hove, B. H., Chen, L., Kupski, S.,

Burghardt, R., & Katzschner, L. (2012). *Urban Climate Map System for Dutch spatial planning*. *International Journal of Applied Earth Observation and Geoinformation*, 18(1), 207-221. <https://doi.org/10.1016/j.jag.2012.01.026>

4. Details of the impact (indicative maximum 750 words)

The impact details of this project are as follows:

Impacts on public policy

Ren et al.'s research has stimulated and informed urban development policy change in mainland China as the Ministry of Natural Resources (MoNR) has endorsed and recommended to conduct wind corridor plan in the Comprehensive Development of Territorial Spatial Planning since May 2019. It is required to review the control range and balanced distribution of open spaces such as structural green spaces and water bodies, as well as the layout and control requirements of ventilation corridors (http://www.gov.cn/zhengce/zhengceku/2019-10/14/content_5439428.htm). In 2020, MoNR further issued the Guidelines for the Compilation of Municipal Land and Space Master Plan (Trial), which is for all cities in China, in their core urban area, the layout and control requirements for ventilation corridors and greenway systems are put forward (<https://m.mnr.gov.cn/gk/ghjh/202008/P020200820547720783027.pdf>). The project team has received the awarded from China Meteorology Administrative and Beijing Municipality to recognize their scientific contribution to government policy development [3-4].

Impacts on Urban Planning and Design Practice

The widespread adoption of the project's urban ventilation assessment and wind corridor plan in over 40 Chinese cities demonstrates the practical impact of the research on urban planning and design practices across the country. Through the development and dissemination of design guidelines [9], technical notes[10], and best practices, this exchange of knowledge has strengthened professional practice, facilitated better-informed decision-making, and promoted healthier, more sustainable urban development. The project's evidence-based scientific knowledge and guidelines have enriched the planning profession by enabling professionals to make better-informed decisions that contribute to sustainable and healthy cities. By adopting the project's findings, urban planners can optimize design flexibility, building height relaxation, building disposition, and urban morphology control. Dr. Ren and her research team have been awarded by the Hong Kong Institute of Planners in 2020 [1] and Hong Kong Green Building Council in 2019 [2] for their contribution to the construction industry and design practice.

Impacts on the environment

Ren et al.'s developed urban ventilation assessment and wind corridor plan has contributed to changes in how urban climate can be applied in urban planning and design and government policy on climate change adaptation, allowing for improving air quality and urban ventilation better and creating a more scientific-based city master plan. This has been noted in the IPCC AR6 (WP11, Chapter 10-Asia) and three Guides issued by the World Meteorological Organization for promotion integrated urban services for cities.

The project is aligned with the Sustainable Development Goals (SDGs), specifically SDG-3 (Good Health and Well-Being), SDG-11 (Sustainable Cities and Communities), and SDG-13 (Climate Action). The project has contributed to the improvement of environmental protection, ecological recovery, air pollution control, and climate change adaptation in Chinese cities. By incorporating the project's findings into city master plans, local governments are better equipped to develop sustainable and resilient urban landscapes that benefit both the environment and the

people living in these areas.

International Reach

Dr. Ren's involvement in the urban climate expert working group for the World Meteorological Organization, focused on the extent to which the urban climate and meteorological service can be improved and promoted. As a key participant in a series of meetings and reviews that led to the developed three Guides [5-7], Dr. Ren contributed her urban climate expertise and application experiences to developed the integrated urban service method model and Hong Kong case has been selected as one of demonstration cases in the Guide [6].

Wider Implications: Dr. Ren has been invited by Arnhem Municipality Government, Meteo France and ETH Zurich Research team to assist in overseas urban climate application and climate change adaptation related governmental consulting project and research projects in the Netherlands, France and Singapore. The findings have been adopted in local planning exercise, such as a new urban development named "urban planning agreements 2010–2020" of Arnhem–Nijmegen in the Netherlands.

5. Sources to corroborate the impact (indicative maximum of 10 references)

1. Silver Award of the 2020 HKIP Award (Research Category), The Hong Kong Institute of Planners (HKIP);
2. Grand Award of the Green Building Award 2019 (Research & Planning Category, co-organised by the Professional Green Building Council (PGBC) and the Hong Kong Green Building Council (HKGBC));
3. 2nd Prize of the 2019 Meteorological Science and Technology Award, The Chinese Meteorological Society, The China Meteorological Administration, China;
4. 3rd Prize of the 2018 Beijing Science and Technology Award (北京市科學技術獎), Beijing Municipality, China;
5. Technical Guide on Measuring, Modelling and Monitoring the Canopy Layer Urban Heat Island (CL-UHI), (WMO- No. 1292), World Meteorological Organization, Geneva, Switzerland; Dr. Ren's Role as Lead Author. ISBN (or other code): 978-92-63-11292-2, Dr. Ren's Role as Lead Author. https://library.wmo.int/index.php?lvl=notice_display&id=22236#.ZF9dW3YzaF4
6. WMO (2021). Guide for Urban Integrated Hydro-meteorological, Climate and Environmental Services, Vol. 2: Demonstration Cities (WMO- No. 1234), World Meteorological Organization, ISBN: 978-92-63-11234-7, Geneva, Switzerland, https://library.wmo.int/index.php?lvl=notice_display&id=21855#.ZF9eT3ZByF4
7. WMO (2019). Guide for Urban Integrated Hydro-meteorological, Climate and Environmental Services, Vol. 1: Concepts and Methodology (WMO- No. 1234), the World Meteorological Organization (WMO), ISBN: 978-92-63-11234-7, Geneva, Switzerland; Dr. Ren's Role as Lead Author. https://library.wmo.int/index.php?lvl=notice_display&id=21512#.ZF9WTnZByF4
8. The Chinese National Guideline titled 'Technical specification for climatic feasibility demonstration in urban master plan (中华人民共和国国家标准：城市总体规划气候可行性论证技术规范, GB/T 37529-2019)', released by the General Administration of Quality Supervision, Inspection and Quarantine of China, Standardization Administration of China, published on 04 June 2019; Implemented on 04 June 2019; Dr. Ren's Role as Lead Author. <https://www.cma.gov.cn/zfxgk/gknr/flfgbz/bz/202209/P020220921706096728200.pdf>
9. HKGBC (2018) HKGBC Guidebook on Urban Microclimate Study, Hong Kong Green Building Council, 16 Jan 2018, Dr. Ren's Role as Lead Author. <https://www.hkgbc.org.hk/eng/engagement/guidebooks/urban-microclimate-study/index.jsp>
10. Industry Technical Note titled 'Specifications for Climatic Feasibility Demonstration – Urban Ventilation ((气候可行性论证规范：城市通风廊道, QX/T437-2018)', released by China Meteorological Administration, published on 11 July 2018; Implemented on 1 Dec 2018; Dr.

Ren's	Role	as	Lead	Author.
https://www.cma.gov.cn/zfxxgk/gknr/flfgbz/bz/202209/P020220921698128809668.pdf				