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2020 INTERNATIONAL CONFERENCE ON RESOURCE SUSTAINABILITY

SUSTAINABLE URBANISATION IN THE BRI ERA



Conference Programme

December 13-15, 2020

University of Nottingham Ningbo China

Table of Contents

WELCOME MESSAGE	1
ORGANIZING COMMITTEE	3
PROGRAMME COMMITTEE	4
PROGRAM OVERVIEW	5
KEYNOTE SPEECHES	6
PLENARY SPEECHES	11
DETAILED PROGRAM	13
Saturday, December 12.....	13
Sunday, December 13	14
Monday, December 14.....	18
PRESENTATION ABSTRACTS	23
13TH DECEMBER 2020.....	23
14TH DECEMBER 2020.....	35
CONFERENCE PROCEEDINGS	56
POST-CONFERENCE TOUR	57
GENERAL INFORMATION	59
Conference Venue	60
Transportation	62
Campus Map.....	63
Accommodation	64
LIST OF PARTICIPANTS	65
CONTACT INFORMATION	69



Conference Website: https://www.icrsconf.com/icrs_urban2020.html

Welcome Message

Welcome Message from the icRS General Chair

Resources are essential for the sustainability of human society. The sustainable management of resources therefore is critical to address many societal challenges. Interdisciplinary approaches are required to develop solutions for sustainable resource management. The International Conference on Resource Sustainability (icRS, www.icrsconf.com) serves as a platform for researchers and practitioners around the world with diverse background and expertise to share the most recent ideas, outcomes, and practices on resource sustainability. At icRS, we define resource broadly, including materials, minerals, food, energy, water, biomass, etc. We also embrace interdisciplinarity, welcoming contributions from engineering, natural sciences, and social sciences. Every year, icRS organizes global conferences, thematic conferences, and regional conferences. To help promote research presented at icRS conferences, we have established long-term strategic collaborations with many key publications in related fields, including *Resources, Conservation & Recycling* (2019 Impact Factor: 8.086).



The icRS Urbanisation 2020 is a thematic conference focusing on the roles of cities and urbanisation in sustainable resource management. We are greatly indebted to the local organisation team led by the conference Co-Chairs, Prof. Faith Chan and Prof. Hing Kai Chan, and the Chair of the Local Organising Committee, Prof. Tiantian Zhang, at University of Nottingham Ningbo China, for the excellent planning and preparation for a stimulating event.

Ming Xu

icRS General Chair

Professor, University of Michigan

Editor-in-Chief, *Resources, Conservation & Recycling*

Welcome

Welcome Message from the icRS Urbanisation 2020 Co-Chairs

It is with great honor and enthusiasm to warmly welcome you to the 2020 International Conference on Resource Sustainability - Sustainable Urbanisation in the BRI Era (icRS Urbanisation 2020) in Ningbo China!

Urbanisation has been a driver for global economic development, but also leads to a lot of urban challenges on social and environmental issues, in particular the Global South and developing countries. Nevertheless, if managed properly it can couple with the sustainable development and hence the future sustainability. The Belt and Road Initiative (BRI) projects will undoubtedly further accelerate the already-rapid development of urbanisation in the upcoming decades. Ningbo City has a long history with an important role as a trade city on the maritime silk-road for centuries. Hosting this conference in Ningbo is of great significance.

icRS Urbanisation 2020 is a thematic conference of the icRS conference series. The conference serves as a platform for the conference participants to share the most recent research on sustainable urbanisation with a focus on the BRI. We have received excellent responses to our call in this extraordinarily difficult time period. The conference also features 5 renowned international keynote speakers, and two brilliant plenary speakers.

This conference would not be possible without the diligent efforts of many volunteers. The conference chairs would like to express our sincere and deepest gratitude and thanks to the programme committee members and organising committee members. In addition, we would also like to thank all session chairs and contributing authors.

We hope you will enjoy attending the conference as much as we have enjoyed organising it.



Faith Ka Shun Chan,
Conference Co-Chair



Hing Kai Chan
Conference Co-Chair



Tiantian Zhang
Chair of the Local Organising
Committee

University of Nottingham Ningbo China

Organizing Committee

Conference Co-Chairs

- **Dr. Faith Ka Shun Chan**
Associate Professor in Environmental Sciences
Geographical Sciences / Faculty of Science and Engineering
University of Nottingham Ningbo China
- **Prof. Hing Kai Chan**
Professor of Operations Management
Nottingham University Business School China
University of Nottingham Ningbo China

icRS General Chair

- **Prof. Ming Xu**
Professor of Environment and Sustainability
Department of Civil and Environmental Engineering
University of Michigan

Local Organizing Committee

- **Dr. Tiantian Zhang (Chair)**
Associate Professor in Economics and Quantitative Methods
Nottingham University Business School China
University of Nottingham Ningbo China
- Ms. Lei Li, University of Nottingham Ningbo China
- Mr. Yuyao Xu, University of Nottingham Ningbo China
- Ms. Jia Luo, University of Nottingham Ningbo China
- Ms. Ying Chen, University of Nottingham Ningbo China

Programme Committee

(in alphabetical order by last names)

- Chunguang Bai, University of Electronic Science and Technology of China
- Zhao Cai, University of Nottingham Ningbo China
- Wei-Qiang Chen, Chinese Academy of Sciences, Institute of Urban Environment
- Ali Cheshmehzangi, University of Nottingham Ningbo China
- Alvin Cheng, University of Nottingham Ningbo China
- Yang Cheng, Aalborg University
- Anthony Shun Fung Chiu, De La Salle University
- Nick Sai Ho Chung, Hong Kong Polytechnic University
- Guowei Hua, Beijing Jiaotong University
- Jing Dai, University of Nottingham Ningbo China
- Meili Feng, University of Nottingham Ningbo China
- Kannan Govindan, University of Southern Denmark
- Chandra Ade Irawan, University of Nottingham Ningbo China
- Carman Ka Man Lee, Hong Kong Polytechnic University
- Lei Shi, Tsinghua University
- Gang Li, Chinese Academy of Sciences, Institute of Urban Environment
- Ming Kim Lim, Chongqing University
- Gang Liu, University of Southern Denmark
- Xiaoquan Liu, University of Nottingham Ningbo China
- Gaoxiang Lou, East China University of Science and Technology
- Ada Hoi Yan Ma, University of Nottingham Ningbo China
- Malin Song, Anhui University of Finance and Economics
- Kim Hua Tan, University of Nottingham
- Zhen Tan, University of Nottingham Ningbo China
- Dimple Thadani, University of Nottingham Ningbo China
- Mike Tse, Cardiff University
- Ming-Lang Tseng, Asia University
- Yutao Wang, Fudan University
- Yaoyang Xu, Chinese Academy of Sciences, Institute of Urban Environment
- Joseph Jie Yu, University of Nottingham Ningbo China
- Cherry Yi Zhang, University of Nottingham Ningbo China
- Qinghua Zhu, Shanghai Jiao Tong University

Program Overview

Saturday, December 12

17:30-20:00	Registration and Welcome Reception*	UNNC-MN Restaurant
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Sunday, December 13

8:30-9:00	Registration	
9:00-9:30	Opening	UNNC Library
9:30-10:15	Keynote Speech 1 - Yongguan Zhu	UNNC Library
10:15-10:30	Group Photo	
10:30-10:45	Coffee Break	
10:45-11:30	Keynote Speech 2 - Wendy Chen	UNNC Library
11:30-13:00	Lunch Break	
13:00-14:20	Parallel Sessions A	UNNC Library
14:20-14:35	Coffee Break	
14:35-15:55	Parallel Sessions B	UNNC Library
15:55-16:10	Coffee Break	
16:10-16:55	Keynote Speech 3 - Dabo Guan	UNNC Library
18:00-20:30	Plenary session - Ali Cheshmehzangi & Cong Cao **	UNNC-MN Restaurant

Monday, December 14

9:00-9:45	Keynote Speech 4- Colin Throne	UNNC Library
9:45-10:30	Keynote Speech 5- Weiqiang Chen	UNNC Library
10:30-10:45	Coffee Break	
10:45-12:05	Parallel Sessions C	UNNC Library
12:05-13:30	Lunch Break	
13:30-15:10	Parallel Sessions D	UNNC Library
15:10-15:25	Coffee Break	
15:25-16:45	Parallel Sessions E	UNNC Library
16:45-17:00	Closing	UNNC Library
18:00-20:30	Conference Dinner & Outstanding Paper Awards **	Xi-Manting Restaurant

Tuesday, December 15

All Day	Post-conference Tour to Xikou (Optional)***	Xikou
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* Light food and drinks provided; conference registration required

** Dinner provided; conference registration required

***Optional and additional registration needed

Keynote Speeches



Prof. Yongguan Zhu, Professor of Environmental Biology, is the Director General of the Institute of Urban Environment, Chinese Academy of Sciences (CAS). He has been working on the biogeochemistry of nutrients, metals and emerging pollutants (such as antibiotics and antibiotic resistance genes). Professor Zhu is a leader in taking multi-scale and multi-disciplinary approaches to soil and environmental problems. Dr Zhu is currently the co-editor-in-chief of *Environmental Technology & Innovation* (Elsevier), associate editor of *Environment International* (Elsevier), and editorial members for a few other international journals. He is a scientific committee member for ICSU program on Human Health and Wellbeing in Changing Urban Environment, and served for nine years as a member of Standing Advisory Group for Nuclear Application, International Atomic Energy Agency (2004-2012). Professor Zhu is the recipient of many international and Chinese merit awards, among them including TWAS Science Award 2013, National Natural Science Award 2009; Professor Zhu has published over 255 papers in international journals, and these publications have attracted over 10,000 citations (Web of Science) with an H-index of 56.

Prof. Yongguan Zhu
Director General of the Institute of
Urban Environment
Chinese Academy of Sciences (CAS)

Biogeochemistry for Resilient Cities

Sunday, December 13

9:30-10:15

Multifunctional Room 1

Traditionally urban resilience refers to recovery from disaster events. However, it has been recently argued that urban resilience is capacity of an urban system to absorb disturbance, reorganize, and maintain essentially the same functions and feedbacks over time and continue to develop along a particular trajectory (Elmqvist et al., 2019). This capacity is derived from the complex interactions of biogeochemical processes with all components (both biotic and abiotic) of the whole urban ecosystem, and therefore urban resilience is multi-faceted, and requires systems approach. This talk will focus on disturbance to biogeochemical cycling (nutrients, contaminants and microorganisms) and how to manage biogeochemical cycling to enhance the capacity of mitigating disturbance and improving urban ecosystem services. We propose the concept of *Peri-URban Ecosystem (PURE)* to forge the urban-rural symbiosis, through which urban organic waste can be recycled and resources can be recovered for ecosystem services (such as food production and green infrastructure). We will also discuss the unsung microbial world relating to urban resilience, particularly in the wake of current global pandemic.

Associate Prof. Wendy Chen

University of Hong Kong

China's Urban Forest: Recreation Potential & Habitat Potential

Sunday, December 13

10:45-11:30

Multifunctional Room 1

Urban forests are defined as “the cultivation and management of all trees (and other vegetation) in and around urban community for the physiological, sociological, economic, and aesthetic benefits provided for the urban society”. They offer a full spectrum of ecosystem services, fulfill important ecological and social functions, and thus play a key role in making cities more liveable and sustainable.

Over the past decade, China's municipal governments have devoted a lot of efforts and resources to augment the provision of urban forest within their jurisdictions due to an increasing recognition of the importance and value of urban forest. Urban forests' recreational potential has been overwhelmingly emphasized and extensively promoted by local governments, yet, their ecological function and environmental benefits have also entered into the political and social agenda sporadically, in tandem with the recent surge of interest in the construction of “Forest City” and “Forest City Cluster” following the “eco-civilization”. Therefore, it is worthy to explore whether urban forests' habitat potential, which is the most fundamental feature of urban ecosystems underlying the supply of a full spectrum of ecosystem services, have been concurrently enhanced in a synergistic manner along with the increase of urban forest provision.

By combining statistical data, empirical monitoring data, and satellite image data covering 31 major cities in mainland China, we attempted to quantitatively analyze the relationship between urban forests' recreational potential and habitat potential to unveil possible synergies, as well as influencing factors, that occur in provision of urban forests during 2011-2018. Implications for policy making and urban planning will be discussed and presented.



Dr. Wendy Chen is an associate professor at the Department of Geography, University of Hong Kong. She is currently the Editor-in-Chief, *Urban Forestry & Urban Greening* (IF: 3.043). Her research interests lie in the interface of two important fields: environment science and economics, which encompasses economic valuation of nonmarket environmental goods, quantification of ecosystem services generated by various ecosystems, the externality of urban planning, environmental pollution mitigations, the interaction of environment and economic development, general environmental problems, environmental policies, and sustainable development strategies in contemporary China.

Prof. Dabo Guan

Tsinghua University

Global Climate Change Mitigation in Post-COVID19 Era

Sunday, December 13

16:10-16:55

Multifunctional Room 1

The global economy is facing a serious recession due to COVID-19, with implications for CO₂ emissions. Here using an adaptive regional input-output model and scenarios of lockdown and fiscal counter measures, we show that global emissions will decrease 3.9% to 5.6% in five years (2020 to 2024), compared with a no pandemic baseline scenario (business as usual for economic growth and carbon intensity decline). Global economic interdependency via supply chains means that blocking one country's economic activities causes other countries emissions to decrease even without lockdown policies. Supply chain effects contribute 90.1% of emissions decline from power production in 2020, but only 13.6% of transport sector reductions. Simulation of follow-up fiscal stimuli in 41 major countries increase global five-year emissions by -6.6 to 23.2 gigatons (-4.7% to 16.4%), depending on the strength and structure of incentives. Therefore, smart policy is needed to turn pandemic-related emission declines into firm climate action.



Professor Dabo Guan is a Distinguished Professor at Tsinghua University, China, and Chair of Climate Change Economics at the University College London, UK. He is the Fellow of Academy of Social Sciences, UK. He specialises in environmental economics for international climate change mitigation, climate change adaptation, scenario analysis on environmental impacts, water resources accounting and management, input-output modelling and their applications in both developed and developing countries. He was a Lead Author for the IPCC AR5. He was the Highly Cited Researcher for 2018 - 2020. He has authored over 190 publications, including 60+ articles published Science, Nature, Nature Research Journals, and PNAS. He received the PNAS Cozzarelli Prize 2014, the Leontief Prize 3 times and the Philip Leverhulme Prize. His paper about climate change impact on beer consumption received the 2018 Altmetric Top 100 award.



Prof. Colin Thorne University of Nottingham

Achieving Urban Flood Resilience in an Uncertain Future: the Blue-Green Advantage

Monday, December 14

9:00-9:45

Multifunctional Room 1

Prof. Colin Thorne is one of the UK's leading expert in urban floods and water management. His expertise covers flood management, rivers and river management, including rehabilitation and restoration for environmental enhancement and rivers and development issues in Asia, America, South America, New Zealand and Europe. He led the UK Research Council (EPSRC funded) Blue-Green Cities and Urban Resilient Cities projects (2013 – 2019). He is also a fluvial geomorphologist with an educational background in environmental sciences, civil engineering and physical geography, published 9 books and over 120 journal papers and book chapters. During a career spanning four decades, has held academic posts at UEA, Colorado State University, the USDA National Sedimentation Laboratory, USACE Waterways Experiment Station, NOAA Fisheries, and the University of Nottingham. He is also a Concurrent Professor at Nanjing University and an Affiliate Professor at Colorado State University.

Globally, cities are rethinking their approaches to urban flood risk and water management in response to the changing hydro-climate, accelerating urbanisation, reductions in public green spaces, and growing recognition of the advantages of multi-functional solutions over piped-drainage systems in tackling social, economic and environmental challenges. In this context, blue-green infrastructure, which comprises a wide range of assets including green and blue roofs, bio-swales, rain gardens, restored watercourses and reconnected floodplains, is becoming established as a key component of urban flood resilience and water security planning and design. A Blue-Green City moves beyond the implementation of integrated treatment trains of blue-green and grey assets, towards the goal of creating a more natural urban hydro-cycle capable of generating multiple benefits that are valued by citizens and communities. In Blue-Green Cities these benefits are distributed in ways that are economically and environmentally sustainable. This paper introduces the Blue-Green Cities concept and presents an overview of research undertaken by the Blue-Green Cities research project. The Blue-Green Cities research consortium envisaged and investigated planning, designed to achieve urban renewal and environmental enhancement, and identify and rigorously evaluate the multiple benefits of blue-green infrastructure. The consortium was centred on 'stakeholder and community communications', and employed cutting-edge research methods in the engineering, environmental and social sciences to advance knowledge and understanding, while ensuring that the outcomes of the consortium (in terms of deliverables) exceeded the sum of its parts.

Prof. Wei-Qiang Chen

Institute of Urban Environment

Material Dependence of Urbanization and Implications for Sustainability

Monday, December 14
9:45-10:30
Multifunctional Room 1

Cities rely on massive amounts of physical, chemical, and biological resources to support their growth and metabolism. These 'metabolic inputs' are accumulated in cities to form material stocks in buildings, infrastructures, transportation facilities, and household appliances. This study takes China's urbanization as an example to illustrate the characteristics of material stock changes in developing countries and compare them with those in developed countries. Results show that (1) material stocks have been growing in China, but have saturated in developed countries, and (2) the major components of urban metabolism are construction and industrial materials (e.g., steel) in developing countries but biomass (e.g., food) in developed countries. The changes in the magnitude and types of material stocks can not only measure urban development but also directly link city and its residents, offering advantages in representing urbanization over the existing indices such as population, land use, or gross domestic product (GDP). Given the new insights provided by material stock, we recommend to embrace it as a critical index of urbanization for guiding urban planning and policy-making.



Wei-Qiang Chen is a professor of Resources and Urban Sustainability at the Institute of Urban Environment, Chinese Academy of Sciences (CAS). He received his bachelor and Ph.D. degrees from the School of Environment at Tsinghua University, Beijing, and was working at the Yale School of Forestry and Environmental Studies during 2010-2015. His research focuses on the (1) urban metabolism and urban complexity, and (2) anthropogenic cycles and trade of resources, especially metals and plastics. His studies have been published in the Proceedings of the National Academy of Sciences of the United States of America (PNAS), Environmental Science and Technology, and other first-level journals. He was elected to the board of the International Society for Industrial Ecology in 2018, and was the founding president of the Chinese Society for Industrial Ecology built in 2015. He is now serving as associate editor for the journals Resources, Conservation, and Recycling and Journal of Industrial Ecology.

Plenary Speeches

Prof. Ali Cheshmehzangi

University of Nottingham Ningbo China

Cities and Facing the Pandemics: From Resilience

Enhancement to Managing the Disease Outbreaks

This plenary talk focuses on the topic of cities and pandemics. In particular, the discussions of this talk highlight the importance of urban/city resilience in facing the disease outbreaks. The ongoing COVID-19 pandemic has had major impacts on urban systems around the globe. It also highlighted the flaws or shortfalls of our day-to-day city operations, urban management, services, and infrastructures. Hence, the topic of resilience has become an important topic of research, especially in facing the pandemics like the COVID-19. To ensure cities are better prepared for the future, we have to invest more on enhancing the resilience of our cities.

By highlighting some of the key points of his recently-published book titled “The City in Need”, the speaker first introduces the topic of resilient thinking, and then highlights two key aspects of adaptive planning and urban management. The main points here address two poles of ‘preparedness’ and ‘responsiveness’ in facing the disease outbreaks. The talk refers to the example of COVID-19 to elaborate on matters of city planning, regional decision making, and resilience enhancement of cities.

The study offers some general lessons from the case of COVID-19 and it offers some insights about how cities should prepare and respond to future pandemic events. The talk concludes with some of the emerging methods to enhance urban resilience and suggests pathways for future urban development and urbanization. In line with the conference’s theme, the talk puts emphasis on the importance of cities and urban management in facing the pandemics.



Professor Ali Cheshmehzangi is Head of the Department of Architecture and Built Environment and Director of the Centre for Sustainable Energy Technologies (CSET), at The University of Nottingham Ningbo China (UNNC). He is a Full Professor in Architecture and Urban Design at UNNC and a Visiting Professor at Hiroshima University, Japan. So far, he has published 80+ journal papers and six books. His two recent books are published in 2020, titled ‘Identity of Cities and City of Identities’ (April 2020), and ‘The City in Need’ (June 2020). His latest book focuses on urban resilience and city management strategies during the disruptive disease outbreaks, specifically related to the COVID-19 pandemic. It is the first published full monograph on the topic of COVID-19.



Prof. Cong Cao

University of Nottingham Ningbo China

Toward an Ecological Civilization:

The Chinese Experience for BRI Countries

Cong Cao is a professor in innovation studies at the University of Nottingham Ningbo China. His research has focused on science, technology, and innovation in China, including scientific elite; human resources in science and technology; research, innovation, and entrepreneurship in nanotechnology and biotechnology; and the reform of science and technology system. He is the author or co-author of four books, most recently, *GMO China: How Global Debates Transformed China's Agricultural Biotechnology Policies* (New York: Columbia University Press, 2018) and *Innovation in China: Challenging the Global Science and Technology System*. Cambridge (UK: Polity, 2018) and some 60 papers in leading international journals and edited volumes. His research has been supported by the U.S. National Science Foundation, European Union's Framework Program (FP) 7, and the National Natural Science Foundation of China, among others.

The talk will draw examples of my own research and teaching in the last decade or so to shed lights on how China's experience of economic development and environmental protection might offer lessons for BRI countries. Apparently, China's political leadership and ordinary citizens have realized the necessity to prevent a point of non-return, or the significant deterioration of the environment and ecosystem as a result of the damages of pollution. This has motivated China to amend its Environment Protection Law to not only raise its awareness of the importance of environmental protection among its citizens but also introduce more stringent measures to protect the environment. The progress in big-data technologies, among others, could help better monitor the effectiveness of efforts in combating air and water pollution. Pollution abatement is so delicate that it may impact the happiness of affected citizens. Indeed, China's mega infrastructure projects such as the construction of the Hong Kong-Zhuhai-Macao Bridge have started to pay special attention to achieving a harmony between human civilization and natural environment. In a word, there needs a systemic and holistic approach toward striking a balance economic development and the protection of the environment and ecosystem.

Detailed Program

Saturday, December 12

Conference Registration

17:30-19:30

UNNC-MN Restaurant

Conference attendees may check in for the conference before attending the Welcome Reception in order to receive their participant badge, event tickets and other conference material.

Registration will take place next to the Welcome Reception on Saturday only. From Sunday to Monday, the registration desk will be located in the UNNC Library, next to the conference venue.

We would be happy to assist you at the help desk regarding:

- Conference registration receipts/Fapiao collection
- Registration for post-conference Xikou tours
- Social event tickets
- Recommendations for Ningbo and its surrounding



Welcome Reception

18:00-20:00

UNNC-MN Restaurant

Participants are invited to attend the Welcome Reception that will take place at UNNC-MN Restaurant. This event warms up the iCRS Urbanisation 2020 Ningbo conference, giving an excellent opportunity to network, meet old friends and colleagues, as well as meet new people as the program begins. Light food and drinks will be served during the event.

Only participants registered to the conference can be given access.

Participants who would like to join the Welcome Reception must arrive at latest **18:30**. Tickets that are not picked up before 18:30 will be given to participants on the waiting list.



Registration
Required

Sunday, December 13

The official opening of the icRS Urbanisation 2020 Ningbo conference will take place in the brand new **Li Dak Sum-Yip Yio Chin-Kenneth Li Library** in the beautiful campus of the University of Nottingham Ningbo China (UNNC).

8:30-9:00		Registration
	Opening Ceremony	– chair by Prof. Hing Kai Chan , Conference co-chair
9:00-9:30	Welcome remarks	– Prof. Ming Xu , icRS General Chair Prof. Patrick Y.K. Chau , Vice-Provost for Research and Knowledge Exchange, UNNC.
	Opening speech	– Dr. Faith Chan , conference co-chair
9:30-10:15	Keynote Speech 1 (on-line)	‘Biogeochemistry for Resilient Cities’ – By Prof. Yongguan Zhu , Chinese Academy of Science
10:15-10:30	Group Photo	
10:30-10:45	Coffee Break	
10:45-11:30	Keynote Speech 2 (on-line)	‘China’s Urban Forest: Recreation Potential & Habitat Potential’ – By Dr. Wendy Chen , University of Hong Kong
11:30-13:00	Lunch Break	(Lunch vouchers are provided to registered participants)
13:00-14:20	Parallel session A	(See page 15 for details)
14:20-14:35	Coffee Break	
14:35-15:55	Parallel Session B	(See page 16 for details)
16:10-16:55	Keynote Speech 3 (on-line)	‘Global Climate Change Mitigation in Post-COVID19 Era’ – By Prof. Dabo Guan , Tsinghua University
18:00-20:30	Plenary Session & Buffet Dinner	(See page 17 for details)



Sunday, December 13

13:00-14:20

Parallel Session A

A1	A2	A3
Sustainable Building Environment & Construction	Waste Management	Urban Soil and Water Management
Multifunctional Room 1, Library Chair: Alvin Cheng	Multifunctional Room 2, Library Chair: Yi Liu	Multifunctional Room 3, Library Chair: Changqing Xu
<p><i>Optimising CO2 Recycling in Novel Cement Production</i></p> <p>Rui Hao, Xiaoguang Qi, and Jin Hooi Chan</p>	<p><i>Impact of Waste Import Restriction on Carbon Emission: Evidence from East Asia</i></p> <p>Yi Liu and Manting Wu</p>	<p><i>Investigation of the Urban Factors Affecting Microplastic Pollution in Chinese Cities: the Case of Ningbo</i></p> <p>Yuyao Xu, Faith Ka Shun Chan, Matthew Johnson, Jun He, Thomas Stanton, Tian Jia, Jue Wang, Zilin Wang, Yutong Yao, Junting Yang, Yaoyang Xu, Xubiao Yu and Dong Liu</p>
<p><i>Interconnecting Polygeneration Energy Systems for Buildings to Accommodate More Renewables and Achieve Emissions Reductions</i></p> <p>Aiyong Rong, Shijun Chen, Minsong Zhang, Weigang Zhou and Chengyong Wang</p>	<p><i>Performance, Environmental Benefit And Economical Analysis of Constructed Wetland Using Construction Waste as Substrate</i></p> <p>Lu Zhou, Zhi Cao and Zhaojun Huang</p>	<p><i>Cost-combined Life Cycle Assessment of Coupled Green and Gray Infrastructure Systems for Runoff Control</i></p> <p>Changqing Xu, Zijing Liu and Haifeng Jia</p>
<p><i>An Investigation of the Performance of Semi-Transparent Amorphous-Silicon and Crystalline-Silicon PV Glazing for Office in Hong Kong</i></p> <p>Chuanrui Yu, Qiancheng Wang, Bingnan Li and Huiyuan Chi</p>	<p><i>Impacts of Government Subsidies on Construction Waste Recycling by Considering Consumer Quality Perceptions</i></p> <p>Lingling He, Hongping Yuan and Jing Liu</p>	<p><i>The Champion of Urban Water Resources Management in the Chinese City – the Case of Ningbo</i></p> <p>Faith Ka Shun Chan, Fangfang Zhu, Lei Li, Miran Lu, Yu-Ting Tang and James Griffiths</p>
<p><i>Material Footprints Driven by the Disaggregated Construction Sector in China’s Provinces</i></p> <p>Lin Liu, Meng Jiang and Bing Zhu</p>	<p><i>Transforming from a Pollution Haven into an Environmentally Friendly Society: the Role of Cutting Overcapacity Policy in China</i></p> <p>Yi Liu and Xiaomei Jiang</p>	<p><i>The Spectrums between China and Other Countries on Online News: the Case of Sponge City Program (SCP)</i></p> <p>Lei Li, Dimple Thadani and Faith Ka Shun Chan</p>

Sunday, December 13

14:35-15:55

Parallel Session B

B1	B2	B3
Sustainable Building Environment & Construction	Urban Sustainable Development	Urban Soil and Water Management
Multifunctional Room 1, Library Chair: Jianli Hao	Multifunctional Room 2, Library Chair: Shaohua Wu	Multifunctional Room 3, Library Chair: Dimple Thadani
<p><i>Activation of Traditional Construction Techniques Used in Linpan Based on the Concept of Sustainability</i></p> <p>Ding Ding, Qianqian Xu, Chunlu Liu and Dingxin Zhang</p>	<p><i>Natural Based Solutions for Regulation of the Health Risk of Urban Soil Pollution</i></p> <p>Shaohua Wu</p>	<p><i>City Water Resources Vulnerability: the Case of Jinan and Qingdao in Shandong Province, China</i></p> <p>Menglu Sun and Takaaki Kato</p>
<p><i>Exploring the Feasibility of Constructing Prefabricated Buildings with Recyclable Materials in Developing Countries</i></p> <p>Qiaopeng Xie and Hung-Lin Chi</p>	<p><i>Regional Performance of Air Pollution Prevention and Control in China: a Gap between Evidence and Perception</i></p> <p>Jinpeng Fu</p>	<p><i>Water Security Transformation of the Mega Cities in the Yangtze River Basin: Comparative Assessment on City and Basin Level</i></p> <p>Ya-Ju Chang and Demi Zhu</p>
<p><i>The Impacts of Big Five Personality Traits on Household Energy Conservation Behaviour: A Preliminary Study in Xi'an China</i></p> <p>Xuan Liu, Izzy Yi Jian, Qiancheng Wang and Qiaopeng Xie</p>	<p><i>City Branding and National Strategy: a Case Study of Ningbo</i></p> <p>Alia Xiang Li</p>	<p><i>Research on Urban Carrying Capacity and Spatial Distribution Optimization Based on Major-Function-Oriented-Zoning</i></p> <p>Nairong Tan, Xiaoying Chang, Wenxi Zhang and Tao Ma</p>
	<p><i>Revealing the Psychological Basis of Green Hotel Visiting Intention with the Extended Theory of Planned Behavior: An Empirical Study in Shenzhen, China</i></p> <p>Yu-Tong Gao</p>	<p><i>Online Social Media- A Vehicle for City Branding in China: the Case of Sponge City Program (SCP)</i></p> <p>Dimple Thadani, Lei Li and Faith Ka Shun Chan</p>

Sunday, December 13

Registration
Required

The Plenary Session

18:00-20:30

UNNC-MN Restaurant

Participants are invited to enjoy this plenary session with light dinner buffet at the UNNC-MN Restaurant. Our distinguished guests, Prof. Ali Cheshmehzangi and Prof. Cong Cao will give short Plenary speeches during the session. This would be another great opportunity to network and meet friends.

Only participants registered to the conference can be given access. Event ticket will be provided at registration.

ADDITIONAL TICKET

Additional tickets to the buffet dinner may be available for purchase at **RMB130/ticket**, subject to availability. If you want to ask for availability, please come to our registration desk.

18:00-18:05	Introduction	– chair by Prof. Martin Lockett , Dean of Faculty of Business, University of Nottingham Ningbo China
18:05-18:30	Plenary Speech I	‘Cities and Facing the Pandemics: from Resilience Enhancement to Managing the Disease Outbreaks’ – By Prof. Ali Cheshmehzangi , University of Nottingham Ningbo China
18:30-19:00	Dinner	
19:00-19:25	Plenary Speech II	‘Toward an Ecological Civilization: The Chinese Experience for BRI Countries’ – By Prof. Cong Cao , University of Nottingham Ningbo China
19:25-20:30	Dinner & Mingle	



Monday, December 14

8:30-9:00		Registration
9:00-9:45	Keynote Speech 4 (on-line)	'Achieving Urban Flood Resilience in an Uncertain Future: the Blue-Green Advantage' – By Prof. Colin Thorne , University of Nottingham
9:45-10:30	Keynote Speech 5	'Material Dependence of Urbanization and Implications for Sustainability' – By Prof. Weiqiang Chen , Chinese Academy of Sciences
10:30-10:45	Coffee Break	
10:45-12:05	Parallel Session C	(See page 19 for details)
12:05-13:30	Lunch Break	(Lunch vouchers are provided to registered participants)
13:30-15:10	Parallel Session D	(See page 20 for details)
15:10-15:25	Coffee Break	
15:25-16:45	Parallel Session E	(See page 21 for details)
16:45-17:00	Closing Remarks	- by Prof. Hing Kai Chan , Conference co-chair
18:00-20:30	Conference Dinner & Best Paper Awards	(See page 22 for details)



Monday, December 14

10:45-12:05

Parallel Session C

C1	C2	C3
Urban Sustainable Development	Logistic, Operational Management and Supply Chain	Urban Soil and Water Management
Multifunctional Room 1, Library Chair: Yu-Ting Tang	Multifunctional Room 2, Library Chair: Cherry Yi Zhang	Multifunctional Room 3, Library Chair: Meili Feng
<i>Impact of Overseas Foreign Direct Investment on Supply Risk Mitigation of Critical Minerals</i> Xin Sun	<i>Green Supply Chain in Construction Sector: Government Intervention, Partnership, Top Management Commitment and Green Practices</i> Ying Xie, Yiqing Zhao and Yahui Chen	<i>Ecological Network Evaluation of Yangtze River Delta</i> Qian Peng, Runhe Xuan and Weihua Sun
<i>Research on the Evaluation Index of Sustainable Land Use in China Based on Production-living-ecological Space and Land Use Functions</i> Yilong Li	<i>A Multi-Agent Platform to Inform Strategies for Briefing Age-Friendly Communities in Urban China</i> Liqun Xiang, Yongtao Tan and Geoffrey Shen	<i>Combining Spatial Multifactor Analysis and Numerical Simulation Methods To Map Flood-Prone Zones Based on the GIS and Hydraulic Model</i> Qian Li and Haifeng Jia
<i>Greening the BRI: Knowledge Transfer in the BRI Environmental Governance</i> Yuxi Zhang	<i>Robust Optimizing a Multi-Period Multi-Objective Closed-Loop Supply Chain Network for Perishable Goods Using Hybrid Heuristic Algorithm under Uncertainty</i> Zhongjia Sun, Jianquan Guo, Chengji Liang and Mitsuo Gen	<i>Evaluation and Prediction of Global Drinking Water Services</i> Runhe Xuan, Qian Peng and Weihua Sun
<i>Progress towards the Sustainable Development Goals and the Implications for Sustainable Management of Geospatial Division: a Case of the Belt and Road Initiative</i> Anqi Xu, Siqi Wang and Kai Fang	<i>Sustainable Drone-Assisted Parcel Delivery under an Uncertain Environment</i> Rui Qiu and Shuhua Hou	<i>Exploring the Ways to Deliver Better Sustainable Water Management Practice in the Sponge City Program (SCP): the Case of Guiyang, Southwest China</i> Yunfei Qi, Faith K. S. Chan, Meili Feng, Emily C. O'Donnell, Gang Li and Colin R. Thorne

Monday, December 14

13:30-15:10

Parallel Session D

D1	D2	D3
Urban Sustainable Development	Urban Sustainable Development and Energy	Waste Management and Climate Change
Multifunctional Room 1, Library Chair: Xiaoguang Qi	Multifunctional Room 2, Library Chair: Nan Xiang	Multifunctional Room 3, Library Chair: Yu-Ting Tang
<i>Relation between Urbanization and Carbon Emissions Based on STIRPAT Model: Case Study of Fujian in China</i> Jingjing Chen and Lihong Peng	<i>Research on Determinants of Urban Residential Electricity Conservation Behaviors Based on Intervention Experiments —the Evidence from Household Survey of 4 Megacities in China</i> Chang Shu, Feng Xu and Nan Xiang	<i>Potential Reduction of CO2 Emissions Under Rebalancing Process in China</i> Ran Wu, Xiaoying Chang and Ping Ma
<i>Environmental Justice in Chinese Contexts</i> Mengqi Shao, May Tan-Mullins and Faith Chan	<i>Development of a Bayesian Copula factorial hydrologic modeling method</i> F. Wang, G. H. Huang, and Y. P. Li	<i>Assessment of the Transition of Municipal Solid Waste Management Using Combined Material Flow Analysis and Life Cycle Assessment</i> Dan Wang, Jun He and Yu-Ting Tang
<i>Spatial-temporal Characteristics and Driving Factors of Coordination Degree of Ecological Efficiency and Industrial Structure Upgrading in the Yangtze River Economic Belt</i> Aoxiang Zhang	<i>Manufacturers' Decisions in a Competitive Environment under Energy Performance Contracting</i> Wenjie Zhang, Hongping Yuan and Zheng Wang	<i>The Typical Strategy Path Analysis on China's Recycling Policies towards the Critical Raw Materials from Spent Lithium-Ion Batteries Based on Tripartite Evolutionary Game Theory</i> Peifan Yao, Lifen Long, Xihua Zhang, Xiaolong Song and Jingwei Wang
<i>Research on Urbanization Model Based on Residents' Perception</i> Lina Zhong, Xiaonan Li and Baolin Deng	<i>Comprehensive Model for Simulation of Economic Transformation and Air Pollutant Control for Steel Cities</i> Fushang Cui, Feng Xu and Nan Xiang	<i>Circular Economy Legislation and Environmental Pollution: Evidence from China's Urban Mining Pilot Base</i> Yi Liu and Hongcheng Shen
<i>System Dynamics Simulation for Regional Environmental Risk Management</i> Jingjing Wang, Fang Wang, Quan Guo, Raymond Tan and Xiaoping Jia	<i>A Review of the Interrelationship between Social Sustainability and Infrastructure: Connotation, Assessment and Future Directions</i> Junwei Ma, Jingfeng Yuan, Huan Zhang	<i>Is Pollution Haven Transfer a Poverty-Environment Trap? Evidence from Carbon Emission Embodied in Waste Import Using SDM</i> Yi Liu and Wanyin Feng

Monday, December 14

15:25-16:45

Parallel Session E

E1	E2	E3
Urban Sustainable Development	Communication and Technologies	Waste Management
Multifunctional Room 1, Library Chair: Chao Wang	Multifunctional Room 2, Library Chair: Cherry Yi Zhang	Multifunctional Room 3, Library Chair: Bo Li
<p><i>Evaluating the Scrap Trade Risk in the Belt and Road Initiative Countries</i></p> <p>Xiaoqian Hu, Chao Wang and Ming K. Lim</p>	<p><i>“I Buy Green Products for My Benefits or Yours”: Understanding Consumer’s Intention to Purchase Green Products</i></p> <p>Ying Sun</p>	<p><i>Optimal Rectangle Packing to Minimize Wastage</i></p> <p>Shijun Chen, Jiyong Xu, Aiyong Rong and Weigang Zhou</p>
<p><i>Resource-Based Contraction Cities in China: from Shrinking Characteristics to Influencing Factors Correlation</i></p> <p>Jing Wei and Jianjun Zhang</p>		<p><i>Development of Sustainable Concrete by Optimization of Aggregate Packing and Cement Paste Volume</i></p> <p>Yuan Jiang, Bo Li</p>
<p><i>Resource Efficiency Research of Ionic Rare Earth Based on the Material Flow Analysis-Taking Ganzhou, Jiangxi as An Example</i></p> <p>Chen Wan, Dan Zhou and Bing Xue</p>	<p><i>CCUS Technology and Hydrogen Industry Integrated Development</i></p> <p>Lingyun Zhang</p>	<p><i>Effects of Climate and Landfill Characteristics on Leachate Physicochemical Properties from A Global Perspective</i></p> <p>Shijun Ma, Chuanbin Zhou and Guang Yang</p>
<p><i>Policy Impact for Construction Waste Management in Yangtze River Delta Region</i></p> <p>Shiwang Yu, Jianli Hao, Yu Song, Conghua Wen and Mingkang Wen</p>	<p><i>Comprehensive Evaluation of Urbanization Development Quality in Fujian Province</i></p> <p>Yaping Zhang</p>	<p><i>EKC of CO2 Embodied In International Waste Import: Evidence From 134 Countries</i></p> <p>Yi Liu and Xueqi Shi</p>

Monday, December 14

Conference Dinner

18:00-20:30

Xi-Manting Banquet Restaurant 喜满庭宴会酒店

The Conference Dinner will be held in the beautiful Xi-Manting Banquet Restaurant. Located in the Water Street leisure centre of the southern business district of Ningbo, Xi-Manting Banquet Restaurant is like a "castle in the air" across the river, with a huge transparent glass roof showing stars all over the sky at night. It is one of the most favourite banquet venues in Ningbo.

PARTICIPANTS ADMISSION

Only participants registered to the conference can be given access.

ADDITIONAL TICKET

Additional tickets to the banquet may be available for purchase at **RMB250/ticket**, subject to availability. If you want to ask

for availability, please come to our registration desk.

TRANSPORTATION

Shuttle bus from campus to the restaurant will be provided, and leaving campus at **17:15**. Please present yourself to the front entrance of UNNC library 10 minutes prior to the leaving time.

ADDRESS

Xi-Manting Banquet Restaurant

(Water Street)

Building No.4, Water Street, South CBD, Rili Road, Ningbo.

喜满庭宴会酒店(水街店)

宁波市鄞州区日丽中路南部商务区水街4号楼



**Registration
Required**

Presentation Abstracts

13th December 2020

■ A1

Sustainable Building Environment & Construction

1. Optimising CO₂ Recycling in Novel Cement Production

Rui Hao (University of Cambridge, UK)

Xiaoguang Qi (University of Cambridge, UK; China University of Political Science and Law, China)

Jin Hooi Chan (University of Greenwich, UK; University of Cambridge, UK)

The cement industry contributes around 5-7% of man-made CO₂ emissions globally with the majority coming from Portland Cement (PC) production. An alternative to PC is the innovative reactive magnesia cement, a blend of reactive MgO and hydraulic binders in certain ratios.

But the production of MgO from calcination of either magnesite (MgCO₃) or seawater/brine remains CO₂ and energy intensive. Hence this research investigates an innovative method to produce MgO from reject brine, a waste Mg source, through carbon sequestration, by its reaction with recycled CO₂, to provide a comparable low carbon manufacturing process.

The experimental results suggest that the final optimum parameters for the production of the carbonated precipitates are: 0.25MgCl₂ + 0.05CaCl₂ + 2.35NaCl + 0.05KCl, 700rpm stirring speed, 25oC room temperature, pH=10.5, and 500cm³/min CO₂ infusion rate. Reaction time is within a day. These parameters are chosen based on the sequestration level, particle performance morphology and the operational convenience.

In this paper, the production of CO₂ in the cement industry and magnesia cement will be compared. The estimation of carbon reduction in the new optimised process in individual-ion system dual-ion system and multiple-ion system will also be

investigated. The mineralised carbon will contribute to the sustainable development in the cement industry. However, the high expenses of the manufacturing will limit the scale of process.

2. Interconnecting Polygeneration Energy Systems for Buildings to Accommodate More Renewables and Achieve Emissions Reductions

Aiyong Rong (Hubei University of Arts and Science, China)

Shijun Chen (Hubei University of Arts and Science, China)

Minsong Zhang (Hubei University of Arts and Science, China)

Weigang Zhou (Hubei University of Arts and Science, China)

Chengyong Wang (Hubei University of Arts and Science, China)

According to report from IEA (International Energy Agency) in 2018, fossil fuels (oil, coal and gas) accounted for 80% of global primary energy consumption. At the same time, there was a great advancement in utilizing renewable energy resources (RES), especially intermittent RES such as wind and solar energy in the power sector. However, the progress of integrating intermittent RES into end-user sectors such as building and industry was not so fast as expected, partially due to limited flexibility mechanisms of the individual systems. Flexibility here mainly refers to the capability of the system that buffers, stores and converts transient surplus power supply from intermittent RES to achieve power grid balance.

Cities consume over two-thirds of fossil fuels and contribute to more than 70% of global carbon dioxide (CO₂) emissions and energy use in buildings accounts for over 40% of primary energy consumption in the developed countries such as European Union and USA. Also, regarding final consumption energy, electricity only account for 18% with over 70% from burning fossil fuels while thermal energy shares more than 50% with 75%

based on fossil fuels. Thus, CO₂ reductions should be achieved effectively in conjunction with thermal heat (heat and cooling) instead of decarbonizing electricity production alone. Moreover, the combined energy production can enhance flexibility mechanisms of buildings to accommodate RES.

Polygeneration refer to simultaneous generation of at least two energy products in a single integrated production process. Electric power, heat and cooling are typical energy forms in buildings. In polygeneration, heat and cooling demands are supplied by utilizing the otherwise wasted heat in the electricity generation process. Thus, when the demands of power, heat and cooling are considered simultaneously, polygeneration can achieve great savings in both fuels and CO₂ emissions if fossil fuels are used as compared with separate provision of energy products. Moreover, polygeneration systems can provide more flexibility mechanisms partially because the independence of energy production can be utilized to adjust the level of electricity production and partially because surplus electricity can be used directly to satisfy demands of heat and cooling via conversion technology. Furthermore, power connection or power transmission is a valuable and viable option to integrate RES into the systems.

This paper attempts to identify further the flexibility mechanisms in the polygeneration building energy systems in the power connection context and review associated optimization techniques for utilizing the flexibility mechanisms to accommodate more intermittent RES because optimization is one of the most effective ways to achieve energy cost and emission reductions by allocating scarce resources reasonably. The high energy efficiency of polygeneration systems in conjunction with the proper usage of flexibility mechanisms will accelerate the building sectors for transition into the future lower carbon building energy systems and support sustainable urban development.

3. An Investigation of the Performance of Semi-Transparent Amorphous-Silicon and Crystalline-Silicon PV Glazing for Office in Hong Kong

Chuanrui Yu (University College London, UK)
Qiancheng Wang (University of Cambridge, UK)
Bingnan Li (University of California, Berkeley, US)
Huiyuan Chi (Harbin Institute of Technology, China)

Due to resource depletion and environmental pollution, research on renewable energy has been conducted for a few years in various professional communities. Building-Integrated Photovoltaics (BIPV) presents tremendous growth potential for building energy conservation. This paper compares the performance of two kinds of solar PV window in BIPV system: namely crystalline-silicon (c-Si) PV glazing and amorphous-silicon (a-Si) PV glazing. The study employs a typical office floor in Hong Kong as a case study. Based on the laboratory test and simulation results, this study reports the performance of two solar PV glazing systems in terms of the daylighting, thermal, electrical and total energy consumption. The analysis results suggest that the amorphous-silicon PV glazing system presents better-daylighting performance and thermal performance, while crystalline-silicon PV glazing performs better in the electrical part. Besides, the study considers the influence of dimming control being applied regarding energy performance. The study found no significant difference in the annual energy performance of two systems without dimming control, while crystalline-silicon PV glazing saves more energy when dimming control is integrated. The results suggest that the energy-saving performance of BIPV systems might be impacted by the type of solar PV system. The findings would provide an informative reference for BIPV technology applications in Hong Kong.

4. Material Footprints Driven by the Disaggregated Construction Sector in China's Provinces

Lin Liu (Tsinghua University, China)
Meng Jiang (Tsinghua University, China)
Bing Zhu (Tsinghua University, China)

The construction sector is one of the most energy and materials intensive economic sectors which drives ~40% of global material flows. China has undergone rapid urbanization over the past two decades. China drives ~30% of global material

footprints in 2010, with 52% of which are driven by its rapidly expanding construction and infrastructure. The construction sector serves an important role in improving resource efficiency and the urban transition towards sustainability in China.

Material footprint (MF) is a consumption-based material use indicator capturing both the direct and indirect material ore required for the final demand of an economy. The environmentally extended multi-regional input-output (EE-MRIO) model is a top-down analysis framework of the material footprints accounting, which provides a whole life cycle perspective on macro-level, by distributing relevant environmental responsibilities to consumers. It is considered as a more comparable and consistent framework to estimate sub-national macro-level footprints. However, the current sectoral resolution of the construction sector in the EE-MRIO model for China is limited, resulting in ~52% MF of China would be attributed to one single sector. The homogeneity of the construction sector limits scholars to obtain insight into different types of building such as residential buildings and infrastructure. Hence it would be meaningful to disaggregate the construction sector and further explored the regional difference of the large country with rapid urbanization.

We hence attempted to disaggregate the construction sector in China's EE-MRIO model by incorporating industrial-level statistics and detailed process-based datasets. As an attempt, we divided the construction into four detailed sectors including residential buildings, civil engineering buildings (the majority of infrastructure), building installation and building decoration, and others. We further analyzed the material consumption and inter-provincial material flow driven by the final demand of disaggregated construction sectors from 2007 to 2012 with a structural decomposition analysis (SDA). We see large differences in MF driven by residential buildings and infrastructure across provinces. It could supplement the insights within the most contributing sector of China's provincial MFs and help us to further understand the macro-level material metabolism of infrastructure giant's construction sector in China's 31 provinces.

■ A2 Waste Management

1. Impact of Waste Import Restriction on Carbon Emission: Evidence from East Asia

Yi Liu (Jiangxi University of Finance and Economics, China)

Manting Wu (Jiangxi University of Finance and Economics, China)

Evidence shows that China's implementation of waste import restriction since the beginning of 2018 provoked the waste import surge of other Asian countries. In order to avoid being the new "pollution haven" of the "North", many Asian countries started to follow China's waste import restriction policy (WIRP). WIRP has great impact on the world waste trade network, however, whether it mitigate environment pollution of these countries has not been answered. The objective of this research is to investigate the impact of WIRP on CO₂ emission. Using time-varying Difference-in-Difference (DID) model and seasonal data from 2015 to 2019, we find that WIRP in Asian countries has significant effects on CO₂ emission embodied in four major categories of waste import. Moreover, the marginal effect of WIRP is increasing. Through the analysis of mediation effects, it is concluded that policy act on the reduction of CO₂ emission through three decomposition channels, namely, economic scale, technological improvement, and structural change. The results are robust using the Difference in Difference model. This finding suggests trade policy on restricting waste import has great impact on world environmental pollution.

2. Performance, Environmental Benefit and Economic Analysis of Constructed Wetland Using Construction Waste as Substrate

Lu Zhou (Tsinghua University, China)

Zhi Cao (Tsinghua University, China)

Zhaojun Huang (Tsinghua University, China)

Constructed wetland is a kind of environment-friendly surface water treatment technology, but the traditional constructed wetland with gravel as substrate has weak phosphorus removal capacity.

Using construction waste as the substrate of constructed wetland can not only reduce the environmental impact of gravel production, but also improve the phosphorus removal efficiency. This study evaluates the environmental impact and costing of traditional constructed wetland, and how much environmental impact and costing will be reduced when traditional CW's substrate is replaced by construction waste. The result shows that compared with the traditional constructed wetland, the environmental impact and costing of constructed wetland filled with construction waste decreased by 77.81% and 14.72% respectively. Natural Land Transformation, Climate Change Ecosystem, Human Toxicity and Fossil Depletion are the main categories of the reduced environmental impact of constructed wetland after the replacement of substrate. The decrease in production and landfill of gravel are the main reasons for the reduction of environmental impact. The paper studies the important factors that affect the environmental impact of constructed wetland and provides a theoretical basis for improving its environmental and economic performance.

3. Impacts of government subsidies on construction waste recycling by considering consumer quality perceptions

Lingling He (Southwest Jiaotong University, China)

Hongping Yuan (Guangzhou University, China)

Jing Liu (Southwest Jiaotong University, China)

The government subsidy is regarded as core motivation of environmental protection industries, including construction waste (CW) recycling. However, CW recycling efficiency is still dissatisfactory in many countries though with subsidy incentives. Existing researches focus more on efficiency of static policies but ignore dynamic change of subsidies by considering consumers' quality perception. To address the research gap, this study aims to investigate the impact of the government subsidies on CW recycling in different market scenarios by considering consumers' quality perceptions of recycled materials. The analysis is facilitated through the development of game theory-based models. Results tell that higher consumers'

quality perception causes smaller subsidy threshold. However, the difference between subsidy threshold and the optimal subsidy leads to subsidy "trap", in which the subsidies are poor efficiency. Though the government is more likely to fall into subsidy "trap" in business cooperation scenario, it can provide less subsidies when disparity of consumers' quality perception is small to avoid trap and promote win-win situation of the two critical stakeholders (i.e. construction material enterprise & waste recycling enterprise). In addition, findings also reveal that differentiated subsidies should be taken into business cooperation scenario to promote all enterprises keep balanced developing and mitigate competition. In the meanwhile, differentiated subsidies on CW recycling would not bring higher expenditure to the government when the difference of consumers' perception is not small. In the end, both theoretical and practical implications are discussed and presented to advance the development of government policy and enterprises decisions in CW recycling market.

4. Transforming from a Pollution Haven into an Environmentally Friendly Society: The Role of Cutting Overcapacity Policy in China

Yi Liu (Jiangxi University of Finance and Economics, China)

Xiaomei Jiang (Jiangxi University of Finance and Economics, China)

This paper investigates the important role played by "Cutting Overcapacity Policy" (COP) in helping China's transform from a "pollution haven" into an environmentally friendly society. To be more specified, to investigate how "Cutting Overcapacity" of China's industrial production can prevent China from being a pollution heaven. China is the "World Factory", massive production of industrial goods requires huge amount of imported recyclable wastes. As a result, the demand for raw materials has made China a pollution heaven of waste. In order to promote the sustainable environmental development, China strengthened the policy of cutting overcapacity with "Supply Side Structural Reform" in 2015. Using Difference-in-Difference (DID) model, the result shows COP can relieve the pressure

of resources scarcity and reduce its dependence on waste import. The marginal effect shows COP decreased waste import of China by 10% from 2016 to 2019. It is to say that COP is the premise of “Waste Import Ban” which has been carried out in 2018. Our result is robust in various kinds of tests, adding new evidence to Pollution Haven Hypothesis.

■ A3 Urban Soil and Water Management

1. Investigation of the Urban Factors Affecting Microplastic Pollution in Chinese Cities: The Case of Ningbo

Yuyao Xu (University of Nottingham Ningbo China, China)

Faith Ka Shun Chan (University of Nottingham Ningbo China, China)

Matthew Johnson (University of Nottingham, UK)

Jun He (University of Nottingham Ningbo China, China)

Thomas Stanton (University of Nottingham, UK)

Tian Jia (University of Nottingham Ningbo China, China)

Jue Wang (University of Nottingham Ningbo China, China)

Zilin Wang (University of Nottingham Ningbo China, China)

Yutong Yao (University of Nottingham Ningbo China, China)

Junting Yang (University of Nottingham Ningbo China, China)

Yaoyang Xu (Institute of Urban Environment, Chinese Academy of Science, China)

Xubiao Yu (Ningbo University, China)

Dong Liu (Institute of Urban Environment, Chinese Academy of Science, China)

Microplastic pollution has become an emerging threat to global freshwater ecological security in recent years. As the concentrated zone of plastic industry and human activities, cities are in a high-risk of microplastic pollution. Urban rivers are constantly transporting microplastic pollution to other areas. In the context of rapid urbanization, Chinese coastal cities are potentially at increasing risks by microplastic pollution towards freshwater,

atmospheric and diverse environments. The discharge of microplastic pollutants are highly associated with human activities. Previous studies also discovered that the urban factors including local population densities, economic structures and land-use patterns also play decisive roles in microplastic pollution in China’s urban catchments. This study focuses on Ningbo, a megalopolis on the East Coast of China, to analyze the specific impacts of urban factors on freshwater microplastic pollution pattern along an urban river channel. The microplastic abundance patterns in the Fenghua River, Ningbo, will be compared with the microplastic pollution situations in other Chinese cities such as Shanghai, Guangzhou, Changsha and Wuhan. This study will also take local urban development in considerations, through revealing the core factors affecting urban microplastic pollution level. This manuscript aims to find countermeasures for controlling China’s urban microplastic emission. These measures will also provide some new perspectives for the Chinese cities to deal with the spread of other artificial contaminants, so as to improve the urban environmental quality and maintain the sustainable development in China, and extensively to other cities in the region.

2. Cost-combined Life Cycle Assessment of Coupled Green and Gray Infrastructure Systems for Runoff Control

Changqing Xu (Tsinghua University, China)

Zijing Liu (Tsinghua University, China)

Haifeng Jia (Tsinghua University, China)

As urban area expands, urban floods happen more frequently, causing great economic losses and adverse impacts on urban ecosystems. Traditionally, grey infrastructure, which are mainly composed of concrete and steel (thus the grey part of the term) and installed as part of the urban drainage system, played an important role in urban flood control. However, rapid urbanization and more frequent extreme storm events instigated by climate change make traditional grey infrastructure become less effective and efficient. New strategies for urban runoff control can be summarized as best management practices (BMPs), low impact

development (LID), sustainable urban drainage systems (SuDS), and water sensitive urban design (WSUD). These new strategies emphasize the use of green infrastructure to protect, restore, or mimic the natural water cycle to effectively and efficiently improve community resilience and quality of life. Green infrastructure complements grey infrastructure to provide effective urban stormwater management. However, green infrastructure cannot replace grey infrastructures completely considering the safety during extreme storm events. In practice, green infrastructure should be used together with grey infrastructure.

This study is focused on the coupled green and gray infrastructures in the residential area. An integrated life cycle environmental and economic assessment method is used to evaluate the environmental impact, environmental benefit, economic cost, and economic benefit of coupled gray and green infrastructure system. This research identifies key factors (i.e., key categories, key process, and key substances) of coupled gray and green infrastructure system and provide suggestions to reduce the potential environmental impact and economic cost. Sensitivity and uncertainty analysis are presented to add reliability to the research. Calculated economic results indicate that combined with the green building subsidy policy, the internal economic cost of integrated green and gray infrastructures is 30% lower than the gray infrastructure. The environmental benefit and economic benefit generated from operation stage of coupled green and gray infrastructures can make the payback time of environmental impact and economic cost within 2.5 years. If green building subsidy policy isn't considered, the payback time of total economic cost will increase two years.

The conclusion will provide quantitative support for the investment and construction of real estate developers. Also, useful information identified will help policymakers make decisions with regard to Sponge City construction problems.

3. The Champion of Urban Water Resources Management in the Chinese City – The Case of Ningbo

Faith Ka Shun Chan (University of Nottingham Ningbo China, China)

Fangfang Zhu (University of Nottingham Ningbo China, China)

Lei Li (University of Nottingham Ningbo China, China)

Miran Lu (University of Nottingham Ningbo China, China)

Yu-Ting Tang (University of Nottingham Ningbo China, China)

James Griffiths (National Institute of Water & Atmospheric Research Ltd, New Zealand)

Ningbo is a coastal megacity located at the East Coast of China and developing rapidly with proactive trading and export economic activities. The city owns a rank of top ten international port and is placed in the major strategic spot of 21st century maritime Silk Road from the “Belt and Road” policy established for promoting further international trades and developments. In future, populations and economy in Ningbo are expected continuously growing in the next few decades. The demand of quality freshwater resources thus is enormously increasing. To follow the initiative of Zhejiang provincial government, Ningbo municipal government has established the “Five water management” (五水共治) policy in 2013 that aims to manage (i) sewage discharge; (ii) flooding; (iii) surface water; (iv) water conservation and (v) freshwater supply. Indeed, the municipal government also liaised and initiated the “Sponge City Program” after 2015 that Ningbo was selected as one of the pilot city; these policies and practices are currently undertaking. This article adopts the case study of Ningbo to investigate the reasons of municipal government to promote the policy, to understand the public perception of this water management policy in Ningbo through conducted semi-structured interviews. During the 2017 and 2019 we conducted a questionnaire (N=110) and interviews (N=10) with the local communities. Our findings indicated that the communities have not been engaged closely with these practices, but generally supporting these two urban water management practices; they agree that the urban water conditions (urban floods and pollution) have been improved. Also, the article discusses whether these (Five Water and SCP) practices can be extensively applied in other Chinese cities. We will provide recommendations at the end of the article.

4. The Spectrums between China and Other Countries on Online News: The Case of Sponge City Program (SCP)

Lei Li (University of Nottingham Ningbo China, China)

Dimple Thadani (University of Nottingham Ningbo China, China)

Faith Ka Shun Chan (University of Nottingham Ningbo China, China)

Sponge City Program (SCP) has been proposed for addressing sustainable water management in China since 2013. With the progression into the key stage for evaluation and transformation towards 2020s and beyond, it is important to understand stakeholders' perceptions on urban water management which in turn lead to better understanding on urban planning and development. The rapid proliferation of global online news media tools has profoundly changed the landscape of how SCP is framed and communicated in the development process. Recognizing online news media is a useful tool understanding the development of SCP in this project, we undertook a systematic analysis on news sources between 2014 and 2020, aim to investigate the perceptions to SCP between Chinese news and other countries, from the perspectives: (1) the background of SCP with perceived links to urban floods, climate change and urbanization; (2) perceived multiple benefits of SCP from environmental, social-cultural and economic aspects; (3) perceived challenges and drivers to the SCP development.

We present that media coverage of the SCP is closely related to the urban water issues especially flood events as expected, while in recent years reinforces aspects of acknowledging community value, social wellbeing, and the importance of sharing experiences for learning. The discourse is prone to advertise the benefits of SCP and promote the implementation of SCP with the significant social-political factors driving behind in China. However, the effectiveness of SCP in facing the risk of extreme weathers, as well as its sustainable development and future legacy in terms of social-political and financial concerns have been challenged and critiqued over time. The number of news articles

published, the frequency of keywords, duration of coverage, the diversity of reporting angels, the language used and methods reporting on SCP-related topic are varied concerning geographical, political, cultural and source standpoint bias.

This paper assesses the extent of disparity in SCP reporting at a global scale between Chinese and other countries' news by using a content analysis and a critical discourse analysis. The state-of-art Blue-Green Infrastructure and urban water management strategies reflected in the news with SCP in a global scale are discussed. Trade-offs and experiences learning across the scale of local, regional, national and international should be highlighted. This paper aims to contribute to understanding the nuances of communication around SCP and the role of online news in reinforcing or changing perceptions of current urban planning and water management perspectives, in prior to achieving more sustainable development goals (SDGs).

■ B1

Sustainable Building

Environment & Construction

1. Activation of Traditional Construction Techniques Used in Linpan Based on the Concept of Sustainability

Ding Ding (Xihua University, China)

Qianqian Xu (Epiphany Architects LLC., China)

Chunlu Liu (Deakin University, China)

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Linpan refers to the rural settlement just like a green plate in the field of western Sichuan Plain, where farmers dwell in the forests of bamboos and trees since ancient times. Linpan is a product of the regional environment, agricultural production, and lifestyle, which conforms to the concept of resource sustainability. The architectural heritage of Linpan contains abundant and excellent construction skills, reflecting the architectural wisdom of local village craftsmen. However, with the wave of urbanization, Linpan is currently facing problems such as weakened function and structural degradation. This paper

focused on the activation of traditional techniques under the background of sustainable urbanization in a logical sequence of "extraction - activation - practice". First, through literature reviews, this paper preliminarily extracted the typical construction system of Linpan, such as the timber frame structure, raw-soil structure, and bamboo-wood binding structure. Second, this study conducted vast site investigations of Linpan and relevant architectural heritage in Chengdu. Third, this study used modeling software such as SketchUp to carry out qualitative construction simulation, and performance simulation software such as DesignBuilder to conduct quantitative numerical analysis on the relationship between construction skills and the built environment. Last, this research practiced the activated construction techniques in the design stage of "BambooUp", namely the Chengdu Bamboo Culture Exhibition Center. This practice took this building as a medium to further demonstrate and inherit excellent construction skills. In general, this paper explored the feasible techniques of regional architecture in Chengdu, from the perspective of architectural history and contemporary architecture, providing a theoretical basis for sustainable construction in urban and rural areas.

2. Exploring the Feasibility of Constructing Prefabricated Buildings with Recyclable Materials in Developing Countries

Qiaopeng Xie (The Hong Kong Polytechnic University, China)

Hung-Lin Chi (The Hong Kong Polytechnic University, China)

Prefabricated buildings have been intensively studied for its multiple virtues, probably to become the main architectural form in the future. However, though prefabricated buildings have attracted enormous interest in energy saving field for its pollution reduction action, its contribution is paltry when compared to the great amount of waste produced in construction, demolition or reconstruction stage. The idea of constructing buildings with recyclable materials may provide a new train of thought. Current application of using recyclable materials to construct prefabricated

buildings is still in the exploratory stage. The corresponding researches are also rare, especially in developing countries. Literature review and qualitative methods were adopted in this study to discuss several successful cases of prefabricated buildings with recyclable materials worldwide, including Rio Future Arena, from the perspectives of policy, technical level, and economic factors. Ultimately, the findings of this study indicated the factors which have significant impacts on the feasibility of implementing recyclable modular buildings in developing countries.

3. The Impacts of Big Five Personality Traits on Household Energy Conservation Behaviour: A Preliminary Study in Xi'an China

Xuan Liu (Hong Kong Polytechnic University, China)

Izzy Yi Jian (Hong Kong Polytechnic University, China)

Qiancheng Wang (University of Cambridge, UK)

Qiaopeng Xie (Hong Kong Polytechnic University, China)

Longli Zhou (University of Leeds, UK)

The residential sector has become a significant energy consumer and carbon emitter in China. Behaviour-driven solutions are widely used for building energy conservation. Research gap exists to understand the impacts of personality traits on the individual differences in energy conservation behaviour. This study aims to explore the roles of Big Five personality traits in household energy conservation behavioural process. The research connects the Big Five personality traits with attitude in the theory of planned behaviour. Through a detailed questionnaire-based survey, the study collected demographics, energy conservation intentions, and personality characteristics from households in two typical communities in Xi'an China. The sample size of the survey consists of 328 households. The structural equation modelling results show that two personality traits play critical roles in household energy conservation behavioural process. Agreeableness positively contributes to energy conservation attitude while Neuroticism presents a negative relationship with the attitude towards household energy conservation. The research offers a shred of an empirical

demonstration on the connection between personality traits and pro-environmental behaviours. The findings would contribute to the energy conservation campaigns in China.

4. Development of a multi-level interactive equilibrium model for multi-region urban carbon emission analysis

Mengyu Zhai (North China Electric Power University)

Guohe Huang (North China Electric Power University, Beijing Normal University)

Yongping Li (North China Electric Power University, Beijing Normal University)

China's commitment at the Paris Climate Conference in terms of economy-wide carbon mission intensity mitigation is causing tremendous pressure on the nation's socio-economic and environmental (SEE) systems. Such pressure is exaggerated due to the imperative requirements for developing economy and improving people's living standards. This is especially significant for the Yangtze River Economic Belt that contains parts of multiple provinces. It is thus desired that multi-provincial analyses of various SEE components within the Basin be undertaken to reflect the interaction of carbon emissions under multiple policies. A multi-level interactive equilibrium (MLIE) model is developed to analyze the compound effects of various regional policies (of YEBT) on other provinces as linked through supply chains, and explore the interactive effects of different policies on related SEE issues. MLIE model is capable of: (i) uncovering the inter-provincial interdependences through changes in the policy for YEBT; (ii) quantifying the interactive effects of carbon-mitigation policy and income/production tax; (iii) examining the short- and long-term impacts of carbon mitigation on the entire economy. By integrating the factorial analysis into the computable general equilibrium and input-output model, the compound relationships between carbon emissions from different sectors and those from different regions could be investigated under given policy scenarios. It is expected that a number of robust decision alternatives would be generated to support policy formulation within a multi-regional context.

■ B2

Urban Sustainable Development

1. Natural Based Solutions for Regulation of the Health Risk of Urban Soil Pollution

Shaohua Wu (Zhejiang University of Finance and Economics, China)

The ecological and environmental problems brought by the rapid urbanization process threaten human health and sustainable development. Pollution removal is an important service of urban green space. How to use natural solutions of ecosystem services to regulate health risks is still lack of in-depth research. In this study, ecosystem services to regulate the risk of urban soil pollution as a case study to explain the application prospects of natural solutions in pollution prevention and control. First we analyzed the relationship between the distribution pattern of polycyclic aromatic hydrocarbons (PAHs) in soil and the landscape pattern of green space. the contribution of pollution emission and pollution removal to the distribution of pollutant pattern was extracted. Then model of pollution removal of urban green space was developed by integrating field investigation, model simulation, and green space optimization. The effect of soil pollution risk regulation under the combination of green space pattern optimization scenarios was simulated. At last, the application of natural based solutions was proposed suggestions on health risk control of PAHs in soil.

2. Regional Performance of Air Pollution Prevention and Control in China: A Gap between Evidence and Perception

Jinpeng Fu (Nanjing University of Posts and Telecommunications, China)

China's unprecedented battle against air pollution began with the implementation of the "Air Pollution Prevention and Control Action Plan" (Hereinafter referred to as the "Action Plan"), issued by the State Council on September 10, 2013, which aims to

improve the overall air quality and greatly reduce the number of heavily polluted days by 2017. So far, it is certain that this powerful measure makes people intuitively feel that the air quality has a significant change for the better, especially in some provinces with serious air pollution in the past. However, the achievement is inseparable from the continuous investment of a large number of national environmental protection special funds.

This paper first focuses on how to evaluate the regional performance of air pollution prevention and control in China based on the special funds for waste gas treatment. Data envelopment analysis (DEA)—this paper adopts a slack based measure (SBM) model with undesirable output—is usually a feasible technique. Different from previous studies, the scale/ capacity of waste gas treatment (due to the missing data for the corresponding year, we will use alternative variables) is added in the model, which is considered to enhance the comparability and authenticity of the calculation results. Further, we calculate the annual average air quality index (AQI) of 31 provincial regions from 2014 to 2017, which will be used to compare with the efficiency value obtained in the empirical part. According to the range of AQI and efficiency value, all regions will be divided into four quadrants, i.e. (high, high), (low, high), (low, low) and (high, low). For the two inconsistent results, including (low, high) and (high, low), this paper will make a specific discussion and analysis, and give the corresponding policy recommendations.

3. City branding and national strategy: A case study of Ningbo

Alia Xiang Li (University of Nottingham Ningbo China, China)

The influence of the multi-level governance structure on Chinese local government behavior in their city branding process has been neglected and under-researched. The Chinese central government introduced the Belt and Road Initiative (BRI) as a long-term development strategy for external engagement and investment, which also has certain impacts on Chinese cities. Multiple cities have been integrating BRI into their city branding strategy,

which links to a more fundamental question on Chinese local government behavior within its broader political system. From a political sociology perspective, this study will take structural functionalism to analyze the city branding process in Chinese cities and investigate the reasons behind the local government behavior. Taking Ningbo as the case study, this research aims to reveal the relationship among the different levels of government. This project will investigate the main question, ‘How do Chinese local governments branding their cities? Why?’. Three subquestions supplement to provide a more detailed analysis: (1) What is the decision-making process of the Ningbo municipal government in determining its city branding strategy?; (2) What are the changes in Ningbo city branding practices before and after BRI launched?; (3) As a national strategy, what is the role of BRI in Ningbo’s city branding strategy?. This study will examine Ningbo’s engagement in BRI with the focus on the interaction with Central and Eastern European Countries (CEEC) in terms of events cooperation, think tank cooperation, and business cooperation.

5. Revealing the Psychological Basis of Green Hotel Visiting Intention with the Extended Theory of Planned Behavior: An Empirical Study in Shenzhen, China

Yu-Tong Gao (New Channel International Education Group Ltd)

The lodging industry has been a critical energy consumer and greenhouse gas emitter in China. Customers present increasing demands for green hotels. However, the psychological factors affecting the green hotel visiting intention of consumers is still unclear. This study aims to investigate the psychological predictors of green hotel visiting intention of customers. To further explain the psychological basis of green hotel visiting behaviour, this study extends the theory of planned behaviour (TPB) by adding two factors: moral norms and past behaviour. The study also tests the role of interactions between the psychological variables in green hotel visiting behaviour. The study conducted

a questionnaire-based survey with a sample size of 500 respondents in Shenzhen, a typical city in southeast China. The survey was conducted between June and September 2019. The study employed structural equation modelling for data analysis. The results indicate that, in addition to three TPB factors, past behaviour and moral norms are also significantly positively related to intention. Besides, the results suggest that the interactions between psychological factors also play essential roles in the green hotel visiting intention. The study provides a novel psychological explanation of green hotel visiting intention. The results might help the development policy interventions towards “sustainable lodging”. Furthermore, the findings would contribute to better marketing and service strategies of green hotels through more effective management of customers' normative processes of pro-environmental decision-making.

■ B3

Urban Soil and Water Management

1. City Water Resources Vulnerability: The Case of Jinan and Qingdao in Shandong Province, China

Menglu Sun (University of Kitakyushu, Japan)

Takaaki Kato (University of Kitakyushu, Japan)

In view of industrial and agricultural economy, Shandong Province holds an important position in China. However, water resources in Shandong Province are scarce compared with other regions, for example up to 12% of the fruits and 13% of the vegetables in China were produced by Shandong Province using only 1% of China's water resources. Economic development imposes great pressure on water environment. Therefore, comprehensive studies on city water resource vulnerability is important to sustainable development in China, especially for Shandong Province.

There are huge regional and climatic differences in Shandong. To make this study more inclusive, the two biggest cities in Shandong Province are studied, Qingdao and Jinan, which represent the coastal and

the inland areas of Shandong respectively. Water resources are vulnerable to climate change, especially precipitation. Since 2010, Shandong has suffered from drought. As a result, water resources in Qingdao decreased dramatically from 20 billion cubic metre in 2011 to 2.87 billion cubic metre in 2015. However, water consumption in Qingdao remains at 9 billion cubic metre and has changed little over recent years. In contrast, water consumption in Jinan is almost 16 billion cubic metre annually, which is much larger than that of Qingdao. We studied the period from 2008 to 2018, using spatio-temporal analysis to describe the water resource vulnerability index. The Water Resources Vulnerability Index (WRVI) is according to the DPSIR (Drive, Pressure, State, Impact, and Response) framework and indicator-component index system, an index is established to qualify water resource vulnerability through water scarcity, water stress, water pollution, and water production efficiency.

The obtained result indicates that drought has a huge impact on water resource vulnerability. Additionally, Qingdao is more vulnerable than Jinan. The policy is useful for reducing some of the cities' demands, but less useful in reducing water resource vulnerability. Climate change has a bigger impact on WRVI. In a short time, government policy has had less impact.

2. Water Security Transformation of the Mega Cities in the Yangtze River Basin: Comparative Assessment on City and Basin Level

Ya-Ju Chang (Shanghai Jiao Tong University, China)

Demi Zhu (Shanghai Jiao Tong University, China)

Urban water security integrates different objectives and needs of urban water management practices, and connects to sustainability development by addressing clean water and sustainable cities. However, current urban water security studies have seldom incorporated urban water management targets and sustainability topics, nor considered the connection of the cities and their corresponding basins. To address the challenges, this study employed the proposed urban water security assessment framework that integrated 15 indicators

for describing the targets of urban water management transitions (achieving towards the water supply city, the sewer city, the drained city, the waterways city, the water cycle city and the water sensitive city) and sustainability topics (encompassing environmental, economic, social and institutional dimensions), to evaluate the water security condition of the mega cities in the Yangtze River basin, namely Shanghai, Nanjing, Wuhan, Chongqing and Chengdu, during 2011-2017. While most of the literature determined indicator weights by collecting stakeholders' subjective judgments, this study applied the Criteria Importance Through InterCriteria Correlation (CRITIC) method to detect an indicator weighting scheme by considering data divergence and indicator interdependencies. This application can improve the robustness of the analytical results, benefit indicator aggregation and increase result comparability. The results showed that Chongqing had the best water security condition in 2017, followed by Shanghai, Chengdu, Wuhan and Nanjing. Moreover, Shanghai has had the largest improvement of the water security condition during the investigated years while Chengdu has showed the least. Shanghai and Chongqing had the leading performance for supporting the water supply city regarding their abundant water resources endowment and coverage of water supply infrastructure, and showed the advantages towards the drained city by means of their advanced drainage system. Chongqing, Chengdu and Shanghai had their superiority in river quality, wastewater and COD regulation to reach the waterways city. Wuhan and Shanghai have lower water intensity to support local economic activities to transition to the water cycle city. For the water sensitive city, Chongqing and Nanjing showed their advantages by the higher government support on environmental protection and the larger societal fixed asset investment in water conservancy, environment and public facilities. Furthermore, the weighting outcome indicated that the condition of water resource endowment, coverage of water supply infrastructure, advancement of drainage infrastructure, COD discharge, water intensity for supporting economic activities, government's support on environmental protection, and societal investment in the fixed

assets of water conservancy, environment and public facilities management, has a larger variation between the five mega cities. At the river basin level, the upstream mega cities have the superiority of water resources endowment, advancement of drainage system, river quality, wastewater discharge, water use, urban greening and government's support of water affairs. The middle- and downstream ones have shown the better performance of water affordability, the density of water supply and sewage network, water intensity of economic activities and government's expenditure of environmental protection. This study contributes to the comparative assessment of water security condition on city and river basin level, and assists tailoring policy measurements to the mega cities to enhance water management practices.

3. Research on Urban Carrying Capacity and Spatial Distribution Optimization Based on Major-Function-Oriented-Zoning

Nairong Tan (Harbin Institute of Technology, China)
Xiaoying Chang (Harbin Institute of Technology, China)
Wenxi Zhang (Ningxia University, China)
Tao Ma (Harbin Institute of Technology, China)

The city serves as the main space carrier for future development elements. From the perspective of the city, we discuss how to improve the urban carrying capacity of resources, environment, ecosystem, and infrastructure, and to improve the carrying capacity and allocation efficiency of economic factors and population of urban agglomerations. From the perspective of the spatial layout of cities, we discuss how the central city and surrounding small cities can be rationally arranged to help form a city cluster as a regional growth pole, and establish a new pattern in which the central city leads the development of city cluster, then the city cluster leads the regional development. China has proposed Major-Function-Oriented-Zoning as a basic sustainable strategy, incorporated spatial characteristics (resource constraints, industry characteristics) into the theoretical analysis through major function zoning. Based on the strategic goals of production, living, and ecology in China for sustainable development, the article explores the realization of planning

objectives from the national to the regional scale, to guide the industries distribution and resource allocation. In the case study, we discussed how regions at different stages of development can play a comparative advantage in the process of sustainable urbanization in China. This part focuses on urban transportation infrastructure, and quantifies how urban transportation infrastructure affects the urban factor carrying capacity of regions in different development stages through the major function accounting and carbon accounting methods, which helps to optimize the spatial distribution of urban industry and population in urban space, agricultural space, ecological space by policy-making and governance.

4. Online Social Media- A Vehicle for City Branding in China: The Case of Sponge City Program (SCP)

Dimple Thadani (University of Nottingham Ningbo China, China)

Lei Li (University of Nottingham Ningbo China, China)

Faith Ka Shun Chan (University of Nottingham Ningbo China, China)

The recent shift of academic attention from city marketing to city branding heralds a new era of representation and signification of cities as brands. Conscious practices of nationwide program implementation could be used not only for urban resilience improvement but also for city brands promotion. In China, to cope with the frequent occurrence of urban floods and droughts, a nationwide initiative called Sponge City Program (SCP) has been launched in 2013. Given the tremendous impact of online social media on brand image, various levels of the Chinese Governments have begun to use online social media for city program promotion. In particular, brand community formed by stakeholders on online social media can significantly influence the brand image by co-creating contents.

In this paper, we first analyze the current application of online social media for city marketing in China based on the case of SCP implementation. Next, we propose a framework/prototype to inform how Chinese' social media could be used for

effective city branding. Finally, we discuss the challenges and opportunities of online social media use in influencing city branding in China.

14th December 2020

■ C1

Urban Sustainable Development

1. Impact of Overseas Foreign Direct Investment on Supply Risk Mitigation of Critical Minerals

Xin Sun (Tsinghua University, China)

Lithium batteries and hydrogen fuel cells are the two most notable energy storages for global clean energy transition. With the sky-rocketing development of their end-use application market, concern on the supply stability of relevant 'critical material' whose function is unreplaceable and production have high uncertainty is heating up. Our study assessed the supply risk of four types of metallic raw materials of special interest, lithium, cobalt, nickel, and platinum, faced by 215 countries and regions by tracing their global trade network. Further we integrated the regional ownership share of foreign production into the risk assessment system treating it as a mitigation tool. We find that China faces the greatest supply risk, but it has mitigated much of it by its companies' overseas foreign direct investment. Europe and America also have a strong influence on upstream commodity supply, but this influence has not done enough to mitigate their own supply risks.

2. Research on the Evaluation Index of Sustainable Land Use in China Based on Production-living-ecological Space and Land Use Functions

Yilong Li (University of Nottingham Ningbo China)

Optimising production-living-ecological space has become one of the cores of China's ecological civilization and sustainable development strategy,

and it is also a crucial goal of land use and management in China. Constructing and identifying a land use evaluation index system based on production-living-ecological space is of great importance to sustainable land use in China. The concept of land use functions can be defined as goods and services provided by different land use types, including production, living, and ecological functions. These functions accord with the purpose of identifying production-living-ecological space. However, few studies have focused on the identification and evaluation of production-living-ecological space from the perspective of land use functions. In this study, literature review methods, comparative analysis, and induction were performed to discuss the conceptual and logical connection between production-living-ecological space and land use functions, and an index system to evaluate the sustainability of production-living-ecological space was constructed based on the multifunctional land use framework. This study will provide a reference for promoting the coordinated development among production-life-ecological functions and creating an evaluation system for sustainable land use in China.

3. Greening the BRI: Knowledge Transfer in the BRI Environmental Governance

Yuxi Zhang (University of Nottingham Ningbo China)

The Belt and Road Initiative (BRI) is a transcontinental policy and investment program that aims at infrastructure development and regional economic cooperation with countries along the “Silk Road Economic Belt” and the “21st Century Maritime Silk Road”. Since an increasing number of regions and countries involved, there is a growing concern over the potential environmental impact of the BRI infrastructure projects. To help address this problem, Chinese president Xi Jinping called for a “green, healthy, intelligent and peaceful” Silk Road. Preliminary efforts have been made by the Chinese government to combine environmental sustainability and green strategies with the BRI, yet in a very conceptual level. As an important practice for China to participate in global environmental governance, it is significant to explore the

environmental governance of the BRI. Meanwhile, it is known that international policy and knowledge transfer processes have played an important role in promoting sustainable innovation and practice. Although a number of studies have been conducted in Green BRI, majority of them focus on five themes: Environmental Challenges, Green Finance, Energy Consumption, Green Products and the connection between BRI and 2030 Agenda for Sustainable development. Few of them focus on the green knowledge transfer in the BRI. Thus, this research will examine the role of knowledge transfer in the BRI environmental governance. Two main research questions will be addressed in this study: 1) Whether or not green/environmental knowledge transferred through the BRI? 2) What impact the knowledge transfer has brought to recipient/partner countries/cities? To investigate the questions above, this research systematically reviews the knowledge transfer related literature in the BRI. The data in this research collects through official government documents, published peer-reviewed literature, media articles and reports. Overall, this research finds that knowledge transfer has played an important in the BRI environmental governance. In future studies, scientists and practitioners should pay more attention to the knowledge transfer in the BRI environmental governance.

4. Progress towards the Sustainable Development Goals and the Implications for Sustainable Management of Geospatial Division: A Case of the Belt and Road Initiative

Anqi Xu (Zhejiang University, China)

Siqi Wang (Zhejiang University, China)

Kai Fang (Zhejiang University, China)

To jointly address pressing societal, economic and environmental challenges, the international community has committed to the Sustainable Development Goals (SDGs) proposed by the United Nations in 2015. Quantifying the nations’ progress towards the SDGs is of significance to making sense of the opportunities and challenges for regional sustainable development and setting goal prioritization. This is particularly important for the

Belt and Road Initiative (BRI) in which countries differ in their socioeconomic stages and environmental impacts. Focusing on the BRI nations, this paper selects a set of indicators to track the progress towards SDGs from 2000 to 2015, employs a global multi-regional input–output (MRIO) model to account for the environmental footprints, classifies them into four categories, and proposes policy recommendations for sustainable management of geospatial division. By doing so, our analysis makes scientific contributions to the literature by: (1) establishing a conceptual framework for bringing together the SDGs indicators and environmental footprints into focus; (2) understanding the potential tradeoffs and synergies between the socioeconomic and environmental pillars of sustainable development; and (3) grouping countries with different socioeconomic and environmental challenges and identifying the solutions. The research findings are expected to provide a full picture of the various opportunities and challenges that the BRI nations face in achieving the SDGs, and come up with a science-based scheme for sustainable management of geospatial division as a basis for embracing a “Green Belt and Road”.

■ C2

Logistic, Operational Management and Supply Chain

1. Green Supply Chain in Construction Sector: Government Intervention, Partnership, Top Management Commitment and Green Practices

Ying Xie (Anglia Ruskin University, UK)

Yiqing Zhao (LinYi University, China)

Yahui Chen (Anglia Ruskin University, UK)

Green Supply Chain Management (GSCM) has emerged as an environmentally sustainable organizational technological innovation. The construction supply chain (SC) is characterised by the project based nature, the large number of actors involved, short term and ad-hoc project relationships, lack of continuity and relatively unstable SC. A systematic literature review of GSCM in construction

reveals that there is a need to identify a mechanism to resolve conflicts among SC actors, to faster the development of relationships among them, and to manage the transition to green SC processes and activities .

The scale and the number of actors in a construction SC make it challenging for a single actor, such as developer or contractor, to manage the transition to GSCM, instead it requires a strong commitment from the top authority level such as national government or municipal government. Government intervention, through regulations, incentives, and coordination backed by real enforcement measures, has been identified as an effective mechanism to influence organisations adopting green practices, and improve firms’ environmental and innovation capabilities. The first research objective explores if government intervention can act as an effective mechanism to resolve conflicts among supply chain actors or to enable the establishment of a collaborative paradigm in construction SC.

The stated benefits of collaboration include shared access to new ideas, more efficient use of resources, reduced duplication of services, shared responsibility for complex issues, and increased ability to address the issues. Collaboration across the construction SC expedites progress on tackling global carbon emission. Government plays a key role in fostering collaborations among SC players, and between SC players with external organisations through knowledge transfer partnership. Under a collaborative paradigm, GSCM has been defined as an emergent environmentally sustainable technological innovation, integrating environmental concerns into organizational SC management activities. Drawing on innovation theory which indicates earlier adopters of ecological innovations gain early adoption advantages, and could share innovative knowledge and good practices for adopting with late adopter counterparts, the second objective is to investigate the knowledge transfer between SC actors, and to analyse the impacts of the knowledge transfer partnership on GSCM adoption.

The role of organisational top management in knowledge advancement and innovation development has been widely addressed in

literature. Top management team plays a key role in articulating a clear vision for GSCM, formulating strategies to implement GSCM and establishing metrics to monitor GSCM performances. The third objective investigates the effects of top management commitment on GSCM adoption.

Drawing data from 209 enterprises in Chinese construction sector, this research performed path analysis, hierarchical mediation regression analysis, and serial mediation regression analysis using Structural Equation Modelling. The research findings show that government regulations are positively related to GSCM adoption under the serial mediation effects of government support and partnership, as well as the mediation effects of top management commitment. The direct effects, indirect effects, and total effects of government regulations on GSCM adoption are analysed and tested through bootstrapping sampling methods.

2. A Multi-Agent Platform to Inform Strategies for Briefing Age-Friendly Communities in Urban China

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Yongtao Tan (RMIT University, Australia)
Geoffrey Shen (Hong Kong Polytechnic University, China)

In response to the challenges from rapid ageing, the World Health Organisation (WHO) has been working for more than a decade to guide global cities and communities to consider, plan and implement age-friendly places where regardless of age or physical conditions, people can live well in later life. Ever since the framework of age-friendly communities (AFCs) have been proposed by WHO, creating AFCs continues to gain momentum throughout the world.

In consistent with the WHO's framework, China National Committee on Ageing (CNCA) proposed the 'liveable environment' concept and implemented pilot projects in several cities as early as 2009. On the basis of the pilot projects, the 2012 version of the 'Law of the People's Republic of China on Protection of the Rights and Interests of the Elderly' introduced a new chapter titled 'liveable environment', thereby making the construction of a liveable environment a

requirement from the legal aspect. Although many efforts have been made to promote AFCs in urban China, challenges remain during the construction process. Engagement and management of stakeholders, budget issues, together with policy perspectives, always challenge communities' pathways to become age-friendly. Therefore, understanding the demands and limitations of multiple stakeholders and coordinating their priorities in an early stage, will be of great help in promoting a certain AFC project in urban China.

Simulation as a tool of analysis and prediction can be applied to propose constructing strategies and explore solutions regarding the above concerns. During the past decades, the multi-agent system (MAS) is developing rapidly due to its capacity of dealing with complicated problems and simulating the real-world phenomena with an agent perspective. It is also the fact that nowadays, there is a transition from the rational actor models to the agent-based modelling (ABM), and the top-down macro decision-making gradually changes to bottom-up micro-stimulation. For a multi-agent system that contains several agents, an agent itself may lack resources, information and capabilities in solving the whole problem, however, interactions between each identifiable agent provide aggregated attributes, which can facilitate decision-making procedures afterwards. Such characteristics make MAS an ideal approach that can be applied to explore constructing strategies for AFCs.

Given the description above, this paper aims to design a multi-agent platform (MAP) to simulate the briefing stage and explore strategies for promoting the AFC projects in urban China. The regulations that different stakeholders are facing to, the interactions amongst stakeholders, together with the connections between stakeholders and the environment are identified; The theory and process to design the multi-agent platform for AFCs are described; The simulation results generated and how such platform can help during the construction process of AFCs are discussed. This research will serve as a reference for researchers and practitioners to further understand the briefing stage and to explore efficient strategies for promoting AFCs in urban China.

3. Robust Optimizing a Multi-period Multi-objective Closed-loop Supply Chain Network for Perishable Goods Using Hybrid Heuristic Algorithm under Uncertainty

Zhongjia Sun (University of Shanghai for Science and Technology, China)

Jianquan Guo (University of Shanghai for Science and Technology, China)

Chengji Liang (Shanghai Maritime University, China)

Mitsuo Gen (Tokyo University of Science; Fuzzy Logic Systems Institute, Japan)

Considering the high demand volatility, short shelf life and sales period of perishable goods, it is necessary to analyze the application of multi-period distribution in closed-loop supply chain network (CLSC) system. At the same time, considering the environmental pollution caused by improper handling, sales and reputation loss caused by untimely delivery, uncertain demand and recovery of perishable goods in different periods, a mixed integer programming (MIP) model and its corresponding robust optimization model of multi-period and multi-objective CLSC network for perishable goods are established aiming at the minimum environmental impact, the minimum economic cost and the maximum on-time delivery rate. The validity and feasibility of robust optimization model were verified by a hybrid heuristic algorithm with a case study of cross-region network covering cities of Shanghai, Suzhou, Wuxi, Changzhou, Jiaxing and Huzhou in Eastern China. The numerical results show that, compared with the single period system, the multi period system has the advantages of good dynamic performance and low system cost, and the multi-objective optimization is better than the single objective optimization on the whole; meanwhile, the importance of uncertain factors in the decision-making of robust optimization model is verified. This research provides important managerial insights about network design and optimal operation of CLSC for perishable goods under uncertainty.

4. Sustainable Drone-assisted Parcel Delivery under an Uncertain Environment

Rui Qiu (Sichuan University, China)

Shuhua Hou (Sichuan University, China)

With the rapid development of the unmanned aerial vehicle, the drone-assisted parcel delivery is emerging. The unmanned aerial vehicle can serve some customers with light parcels to save fuel and time costs as well as reduce the environmental influence, which is beneficial for sustainable urbanization. This paper investigates the sustainable drone-assisted parcel delivery under an uncertain environment by a mixed-integer linear model. Then a case study is given to show the efficiency and practicality of the proposed model in freight cost saving and carbon emission mitigation. The results indicated that the model can assist freight companies in making decisions for sustainable drone-assisted parcel delivery.

■ C3 Urban Soil and Water Management

1. Ecological Network Evaluation of Yangtze River Delta

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Runhe Xuan (Shanghai Normal University, China)

Weihua Sun (Shanghai Normal University, China)

Introduction: the Yangtze River Delta is a region with a high degree of urbanization in China. However, the destruction of ecosystems caused by human activities has attracted extensive attention, evaluation of ecological environment quality has become the focus of current research. Due to poor availability, serious data missing, and limited spatial analysis ability of traditional statistical data, remote sensing technology with the advantages of real-time, fast, and a wide range, has been widely used in the field of ecological environment, such as vegetation index was used to monitor vegetation, water body index was utilized to extract urban water body information, the surface temperature was used to measure the urban heat island effect. In this paper, the remote sensing ecological index (RSEI) was selected to evaluate ecological environment of the

Yangtze River Delta. Ecological characteristics were analyzed from greenness, wetness, dryness and heat, and combined with the environmental indicators.

Methods: the research area including 26 cities in the Yangtze River Delta. Landsat 8 remote sensing images were chosen during 2017-2020. The RSEI index was calculated through radiometric calibration and atmospheric correction, index calculation, principal component analysis, image stitching and cropping, and partition statistics. The principal component analysis was carried out in combination with 8 indicators in the "Statistical Yearbook of Chinese Cities", and social network analysis was used to constitute urban agglomerations ecological network by Ucinet 6.

Conclusions: after removing the water body (about 9% of the total area), the RSEI was divided into 5 levels (Fig.1). In general, the Yangtze River Delta has a good ecological environment, of which the "excellent" accounted for the most area (32.87%), followed by "good" (24.86%), mainly distributed in the east and south of the study area. The areas classified as "worse" (15.01%) and "poor" (11.06%) are mainly distributed around Taihu Lake and the northeast of the study area. These areas have concentrated population and less vegetation, which require more environmental remediation, especially increased green coverage. As shown in Fig.2, the ecological network density and standard deviation were 31.61 and 65.47, indicated urban ecology was highly correlated. Therefore, the ecological green integrated development of the Yangtze River Delta has feasibility. However, the ecological connection in urban agglomerations of the Yangtze River Delta was polarized. Nanjing, Maanshan, Zhenjiang, Yangzhou, Shanghai, Hangzhou, and all of them showed a certain radiation effect to the surrounding cities. On the other hand, some other cities had weak ecological links, especially Jinhua and Taizhou, which need to strengthen ecological cooperation and coordinated development.

The agglomeration subgroups of ecological network were shown in Fig.3. There were 4 secondary agglomeration subgroups and 8 tertiary agglomeration subgroups. The correlation degree between cities was greatly affected by regional connections and less affected by the administrative

boundary. Internal correlation degrees of tertiary agglomeration subgroups were high, "Nanjing - Chuzhou" was the highest, whose value was 307.435, and "Ningbo - Zhoushan - Taizhou" was the lowest, with a value of 54.647. On the contrary, most of the correlation degrees between subgroups were less than 10. This indicates that there are strong, direct, and regular ecological connections between the same agglomeration subgroups, while cities from different agglomeration subgroups need to strengthen ecological cooperation in resource utilization, environmental governance and other aspects.

2. Combining Spatial Multifactor Analysis and Numerical Simulation Methods to Map Flood-Prone Zones Based on the GIS and Hydraulic Model

Qian Li (Tsinghua University, China)

Haifeng Jia (Tsinghua University, China)

With rapid urbanization, flooding is one of the most prominent public concerns around the world. Existing evaluations on flood-prone zones mainly involved either a multifactor analysis or a numerical simulation method. However, there is still a gap in how to enhance the reliability and practical applicability of evaluation results by combining these two approaches. We developed a framework of flood risk assessment based on spatial multifactor analysis and hydraulic model simulation methods and applied it to the Pingshan River catchment in Shenzhen, China. The spatial multifactor analysis was performed on the platform of a geographic information system (GIS) to generate a flood risk map across the entire catchment. Factors contributing to the spatial distribution of risks, including human and natural environmental elements, were selected. Meanwhile, the model simulation with multiple designed-rainfall scenarios was performed using the 1D module of the InfoWorks ICM software to identify flood-prone sites in the catchment. Three indicators were employed to characterize flood-prone sites, i.e., the critical recurrence period, the inundation depth, and the inundation duration time. The smaller the critical recurrence period of a given point of interest, the

more likely flooding will occur. To establish the relationship between the multifactor analysis and the model simulation, we developed a flood risk grading system based on the two indicators of the inundation depth and duration time. We first validated the risk map against historical inundation sites before making a comparative analysis with model simulation results.

3. Evaluation and Prediction of Global Drinking Water Services

Runhe Xuan (Shanghai Normal University, China)

Qian Peng (Shanghai Normal University, China)

Weihua Sun (Shanghai Normal University, China)

Water is the basic source of life. Rational utilization of water resources is an important basis for sustainable economic and social development. However, due to the intensification of the urbanization, water resources have been sharply reduced. Although 91% of the world population used improved drinking water sources in 2015, 663 million people still used unimproved sources such as unprotected springs, wells, and surface water. The Sustainable Development Goals (SDGs) aim to substantially improve water and sanitation globally and include two specific targets within Goal 6 for drinking water, sanitation, and hygiene (WaSH). In this paper, a gray model was adopted to predict SDG 6.1.1 (Proportion of population using safely managed to drink water services) of all countries, and evaluate which countries can achieve the target on time by 2030, to ensure full coverage of safe and managed drinking water services. Besides, the influencing factors of water resource security management and its relation to the economy and population were analyzed.

4. Exploring the Ways to Deliver Better Sustainable Water Management Practice in the Sponge City Program (SCP): The Case of Guiyang, Southwest China

Yunfei Qi (University of Nottingham Ningbo China, China)

Faith K. S. Chan (University of Nottingham Ningbo China, China)

Meili Feng (University of Nottingham Ningbo China, China)

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Colin R. Thorne (University of Nottingham, UK)

Urban environmental problems such as waterlogging, pollution, etc., lately have become severely significant in many Chinese cities. Socio-ecological based practices such as the Nature Based Solutions (NBS) are influencing the Sponge City Program (SCP), which aimed to solve the urban water issues in Chinese cities. However, SCP is currently over-focused on the engineering design and construction processes, and overlooked the social-economic and ecological factors. Rapid urbanisation and expansion of population and landuse changes caused severe urban water issues, such as surface water flooding (waterlogging); urban freshwater pollution, etc., the upcoming challenges are hugely exacerbated also by climate change. This study adopted the case of Gui'an, a new town district in Guiyang (in SW China) for the current approaches in the SCP, which aims to explore the opportunities, barriers and constraints and deliver better implementation strategies towards managing urban water issues sustainably long-term. This research focus to explore the stakeholders (e.g. via practitioners, scholars and the public) by 20 in-depth semi-structured interviews; through these results, we analysed that the social perceptions, finance, and institutional arrangements are the major concerns; but the program also have provided opportunities for addressing the urban floods and water issues, improving urban ecosystem services and social wellbeing, etc., which provides the future roadmaps on delivering sustainable water management practices by this case study. Our findings can contribute to improve the delivery of SCP practice, especially in the 2nd and 3rd stage in Guiyang and extensively providing valuable lesson for other 29 pilot SCP cities in China.

■ D1

Urban Sustainable Development

1. Relation between Urbanization and Carbon Emissions Based on STIRPAT Model: Case Study of Fujian in China

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Lihong Peng (Xiamen University, China)

The process of urbanization requires more energy consumption, resulting in increased carbon dioxide emissions. As a coastal province of China, Fujian has grown its economy rapidly between 2005 and 2017, with GDP increasing by about 4.3 times. At the same time, urbanization rate has increased from 49.42% to 64.79%, while energy consumption also has increased about 4.9 times. Research on the impact of urbanization on carbon emissions has great significance to the development of low-carbon cities. Based on the data of Fujian Province from 2005 to 2017, the Stochastic Impacts by Regression on Population, Affluence, and Technology (STIRPAT) model is used to examine the impact of urbanization on carbon emissions this study. The results show that, factors such as per capita GDP, urbanization rate, and carbon intensity have a significant impact on Fujian's carbon emissions. The urbanization level plays a positive role in promoting carbon emission during the sample period. Carbon emission intensity has been declining since 2005, and it has certain inhibitory effect on carbon emission. From the policy perspective, constructive suggestions for policymakers to mitigate carbon emissions and develop the low-carbon cities are provided in this paper.

2. Environmental Justice in Chinese Contexts

Mengqi Shao (University of Nottingham Ningbo China, China)

May Tan-Mullins (University of Nottingham Ningbo China, China)

Faith Chan (University of Nottingham Ningbo China, China)

Based on the principle that “all individuals are entitled to live in an environment adequate for their health and well-being” environmental justice has become increasingly influential when studying environmental sustainability at local level, especially in today's era of rapid urban and industrial development. Nevertheless, the application of the concept of environmental justice is continuously expanding topically and geographically to embrace plurality. Researchers further state that the discourse of environmental justice should vary from context to context, as the differences of environmental, social, cultural, economic aspects between contexts could shape unique local notions of environmental justice. Thus, this research will discuss the common ground and the uniqueness of the environmental justice study framework and promote the concept “environmental justice capital” for studying different discourses of environmental justice. Additionally, “environmental justice capital” will be put in Chinese contexts as an preliminary examination, as well as to study what environmental justice is in Chinese contexts, which is different from the concept defined and well-recognized in western countries.

3. Spatial-temporal Characteristics and Driving Factors of Coordination Degree of Ecological Efficiency and Industrial Structure Upgrading in the Yangtze River Economic Belt

Aoxiang Zhang (University of South China, China)

Taking 108 cities in the Yangtze River economic belt as the research object, this paper analyzes the coordination degree level and spatial-temporal evolution characteristics of ecological efficiency and industrial structure upgrading in the Yangtze River economic belt from 2007 to 2017 by using super efficiency SBM model, coupling coordination degree model and spatial autocorrelation method. The dynamic spatial Durbin model is used to analyze the driving factors of the spatial-temporal evolution of the coordinated scheduling. The types of coordination degree are mainly between moderate imbalance and primary coordination. Cities with

higher coordination level form a T-shaped distribution pattern extending from coastal cities in downstream areas to inland areas. Coordination degree has strong spatial dependence and spatial heterogeneity. The coordination degree has obvious path dependence, and the spatial spillover effect of coordination degree is significant. The increase of coordination degree of neighboring cities will improve the coordination degree of this city. The increase of population density, the optimization of system quality, the increase of foreign investment, the strengthening of environmental regulation and technological progress are conducive to the increase of coordination degree, while the increase of foreign investment in neighboring cities and the strengthening of environmental regulations will lead to the decrease of coordination degree.

4. Research on Urbanization Model Based on Residents' Perception

Lina Zhong (Beijing International Studies University, China)

Xiaonan Li (Beijing International Studies University, China)

Baolin Deng (Beijing International Studies University, China)

Liyu Yang (Beijing International Studies University, China)

Xiangchi Qi (Beijing International Studies University, China)

Driven by many factors, a large number of urbanization models have emerged in China's urbanization development. However, the existing research rarely involves comparing the development of urbanization quality of different models from the perspective of residents' perception. To make up for this research gap, this paper selects 15 non-industrial urbanization rural areas to investigate the development of five types of urbanization: tourism urbanization, real estate urbanization, trade urbanization, science and education urbanization, agricultural urbanization, and transportation urbanization. Through a questionnaire survey, we know the feelings of residents in the process of rural urbanization from three aspects: economic life impact, social life impact, and environmental life impact. By comparing the differences of residents'

perceived quality in different urbanization models, the research results show that compared with other urbanization models, traffic urbanization has many shortcomings, and residents are not satisfied with the economy, society, and environment. Residents of agricultural urbanization are satisfied with the local economy, society, and environment. However, in the development of commercial urbanization, environmental protection is neglected. Because tourism has a low peak season, the residents' perception of economic improvement is not obvious. Residents of real estate urbanization are satisfied with the government and income, while residents of science and education urbanization are generally less satisfied with the economy, society, and environment. By summarizing the development characteristics, advantages, and disadvantages of different urbanization models, this paper puts forward some suggestions on how to improve the quality of urbanization development.

5. System Dynamics Simulation for Regional Environmental Risk Management

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Fang Wang (Qingdao University of Science and Technology, China)

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Xiaoping Jia (Qingdao University of Science and Technology, China)

The total output value of the chemical industry in China will reach CNY 16 trillion by 2020. Chemical industrial parks (CIP) are a practical form of industrial symbiosis network to promote resource sharing among the participating chemical companies. They often have great environmental risks that need to be managed in a cost-effective way. Our previous work developed a game theoretic model between chemical plant and insurance company for environmental pollution liability insurance (EPLI) implementation in environmental risk management via a risk payoff matrix. However, existing EPLI products cannot meet the requirements of insuring highly complex environmental risk in CIPs. This work focuses on EPLI applicability in park-wide risk

management. The interactions among stakeholders, i.e., chemical companies, insurance company, and local government, are investigated using system dynamics (SD). The SD model for EPLI considers the interactions of output value, risk level, related government policies, and insurance products. SD is used to comprehensively depict the causality relationships among stakeholders and simulate trends over time. This work proposes three scenarios, e.g. single companies, multiple coalitions, grand coalition. A practical case study of a chemical industrial park is used to illustrate the model.

■ D2

Urban Sustainable Development & Energy

1. Research on Determinants of Urban Residential Electricity Conservation Behaviors Based on Intervention Experiments —The Evidence from Household Survey of 4 Megacities in China

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Feng Xu (Beijing University of Chemical Technology, China)

Nan Xiang (Beijing University of Technology, China)

Residential electricity consumption amount and ratio keep steadily increase trend as economic development in China. As a major composition of the total carbon emission in China, the carbon emissions from residential electricity consumption continue to grow. Residential electricity conservation has special significance for carbon emission reduction. Therefore, it is necessary to study the determinants of residential electricity conservation behaviors. Based on data from 635 survey questions collected in four typical megacities (Beijing, Hangzhou, Guangzhou and Guiyang) in China, this article analyzed the determinants of electricity saving behaviors by means of multivariate regression model, and assessed residential electricity conservation potential under four price intervention experiments. The results are as follows: (1) Family income, geographic features show significant influences

towards resident electricity conservation behaviors. The groups with higher income lack control over the electricity consumption. In this case, citizens in Beijing and Guiyang show higher awareness to save energy than those in Guangzhou and Hangzhou. (2) Confronting electricity price increase, residents' energy-saving potential are higher along with price adjustments. When the electricity price rises by 0.05 CNY, 0.1 CNY, 0.2 CNY, and 0.5 CNY, residents are willing to reduce electricity consumption by 4.36%, 8.33%, 13.39% and 21.04%, respectively. Based on these findings, this paper indicates that it is effective to expand ladder price differences across different income groups which can better meet the overall demand for electricity.

2. Development of a Bayesian Copula factorial hydrologic modeling method

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G. H. Huang (North China Electric Power University, China; Beijing Normal University, China; University of Regina, Canada)

Y. P. Li (North China Electric Power University, China; Beijing Normal University, China)

Assessing the impacts of climate change on hydrologic regimes through hydrologic modeling is challenged by the interactions of climate variables (or predictors) (e.g., precipitation and temperature in various lead months), the uncertainties of data, predictors and hydrologic models, the impacts of non-predictor factors (e.g., other climate variables, land cover, and human activities), the heterogeneities of climate-change impacts, as well as their interrelationships. Accordingly, a Bayesian Copula factorial hydrologic modeling method (BCFHM) is developed in this study to overcome the challenge, enhance the reliability of ensemble hydrologic prediction, and provide scientific support for climate-change impacts assessment and adaptation under these complexities. In BCFHM, multi-level factorial analysis and other methods (e.g., data-driven methods and conditional Copula) are integrated with ensemble hydrological modeling (i.e., Bayesian Model Averaging). BCFHM is applied to quantitatively analyze the rainfall-runoff relationships of 16 catchments over China. Results

reveal that the errors of ensemble hydrologic modeling, mainly originating from anthropogenic impacts on runoffs, vary with predictor selections and seasons and their distributions can be well captured by conditional Copula functions. They also point out the necessity of taking into account non-climatic impacts and experimental replication in multilevel factorial analysis, and demonstrate the consequences of neglecting them. Multilevel factorial analysis can accurately reveal both individual and interactive impacts of climate variables on hydrologic processes, and the impacts of non-climatic factors. As the most important finding of this study, climate-change impacts on hydrology show significant spatial heterogeneities over China. For instance, contemporaneous climatic conditions dominate (57.73%-61.63%) runoff changes and variations in Southern China, while precedent climate conditions pose significant impacts (28.43%-65.65%) on runoffs in Northern China; the overall influence of non-predictor factors on runoffs decreases by 0.12% for the catchment-area increment of 10000 km² and ranges from 1.91% to 24.70% over China.

3. Manufacturers' Decisions in a Competitive Environment under Energy Performance Contracting

Wenjie Zhang (Guangxi University for Nationalities, China)

Hongping Yuan (Guangzhou University, China)

Zheng Wang (Southwest Jiaotong University, China)

Energy performance contracting (EPC) is an innovative energy efficiency mechanism. Under EPC, an energy service company (ESCO) provides a series of energy-saving services to an energy user (EU) and shares the energy-savings with EU together with a fixed sharing ratio. As a result, the ESCO gains the profits and the EU reduces its energy consumption, achieving a win-win situation. Therefore, EPC is very valuable to deal with the cooperation-competition problems in sustainable supply chain. In this paper, we consider two manufactures competing in the market, and they produce and sell homogeneous products. In order to improve energy efficiency and reduce the energy consumption costs, the

manufacturer with less energy-efficient in production can provide an EPC contract to the more energy-efficient manufacturer. and once the more energy-efficient manufacturer accepts the EPC contract, it will become the ESCO, while the inferior manufacturer will become the EU according to the framework of EPC. Based on game model, we discuss the cooperation-competition problems of the two manufacturers and analyze the optimal EPC cooperative decisions in the competitive environment. The results show that: (i) When both manufacturers decide to carry out EPC cooperation, the market equilibrium price will decrease and the overall market product sales will increase. (ii) Whether two manufactures decide to carry out EPC cooperation depends on the market size and the revenue sharing ratio in EPC. (iii) When the market size is small, the inferior manufacture has to carry out EPC cooperation with the superior one; otherwise it will be eliminated from the market eventually. In addition, in the extension part, we explore the EPC cooperation decisions of two manufacturers when the more energy-efficiency manufacturer decides to retain a part of energy-saving technology in EPC cooperation. The findings show that there is an optimal level of technical cooperation where both manufacturers can achieve the optimal benefits. The research provides a path to deal with the cooperation-competition problem in a Duopoly market.

4. Comprehensive Model for Simulation of Economic Transformation and Air Pollutant Control for Steel Cities

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Feng Xu (Beijing University of Chemical Technology, China)

Nan Xiang (Beijing University of Technology, China)

The steel-manufacturing intensive cities (steel cities) in China are facing a dilemma of economic transformation and air pollutant control. In this case, taking Tangshan as the research object, this study intends to simulate the developing trends of steel cities and verify the effect of economic transformation by 2020 to explore the development

rule of steel cities. The theories and methods of system dynamics, input-output theory and econometrics were adopted to establish a comprehensive evaluation model based on the detailed analysis of economy-energy-environment (3Es) coupling mechanism in Tangshan. The input-output model is the basis for the economic model. It combines two sub-models (energy model and environment model) together through industrial production. Inter-industry development constraints are adopted as the basis of industrial and economic development. Furthermore, the sub-models shall reflect the material and energy flows within or between models. The multi-objective dynamic simulation from 2016 to 2020 was carried out by the comprehensive evaluation model. The simulation results show the gross production of Tangshan would get slow in the period of prediction. Compared with the data in 2016, the gross production increases only 11% in 2020. It even shows a decline of 1.4% in 2019, which conforms to the reality. The steel industry decreased 34.6% during this period, showing that its development was heavily impacted with the target of both economic transformation and air quality improvement. The simulation results are consistent with the real data. The accuracy of the comprehensive evaluation model and reliability of the prediction can be confirmed. It is difficult for Tangshan to achieve the dual goals of economic development and air pollution reduction by 2020 if it maintains the current level of economic structure and pollution control level. Adjustment of industrial structure would be the key way for a more reasonable development.

5. A Review of the Interrelationship between Social Sustainability and Infrastructure: Connotation, Assessment and Future Directions

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Jingfeng Yuan (Southeast University, China)

Huan Zhang (Southeast University, China)

Social sustainability has a prominent impact on infrastructure. The interrelationship between social sustainability and infrastructure attracts attentions

from both researchers and practitioners. This study conducts a scientometric review of research on the interrelationship between social sustainability and infrastructure in 1977-2019 to identify the state of the field and trends, through co-author analysis, co-word analysis, and co-citation analysis. A total of 385 bibliographic records from the Web of Science (WoS) core collection database were analyzed. The results indicated that the studies on the interrelationship between social sustainability and infrastructure research are focused on two areas. The first research area aims to explore the connotation of social sustainability on infrastructures. The second area focuses on assessment of social sustainability in different regions. Finally, this review identified bursts in the hybrid network of terms and journal co-citations, which can provide guidance for future research.

■ D3 Waste Management & Climate Change

1. Potential Reduction of CO₂ Emissions Under Rebalancing Process in China

Ran Wu (Harbin Institute of Technology, China)

Xiaoying Chang (Harbin Institute of Technology, China)

Ping Ma (Harbin Institute of Technology, China)

This paper analyses the effect of economic growth on CO₂ emissions' growth from an overall perspective, supply-side perspective and demand-side perspective. Based on database of emissions and economic structure at provincial level from 1997 to 2015, regression models are built to analyse the impact of different items' growth on emissions' growth. Results show that contribution of secondary industry's growth is the most important factor on increasing emissions growth in supply side. Growth contribution of consumption and net outflow are the most important ones in demand side. However, due to the tiny share of net outflow and inventory change, consumption actually becomes the most important factor to induce emissions as a result. Additionally, predictions are made based on official forecast of future economic structure in China, and supply-side

structural change can be more helpful to reduce CO₂ emissions while increasing share of consumption in demand-side structural change will hinder emission reduction.

2. Assessment of the Transition of Municipal Solid Waste Management Using Combined Material Flow Analysis and Life Cycle Assessment

Dan Wang (Taizhou University, China)

Jun He (University of Nottingham Ningbo China, China)

Yu-Ting Tang (University of Nottingham Ningbo China, China)

To combat the adverse impacts from municipal solid waste (MSW) management and to improve the sustainability of MSW management in Europe, waste directives have been successively introduced for diverting waste from landfills to more environmentally friendly management options at the upper layers of waste management hierarchy such as recycling and energy recovery. Previous studies often focused on the challenges of meeting management targets, the influences of the EU waste directives on waste management legislations and practices, and the evaluation of the environmental impacts of potential waste management scenarios or technologies; however, the transition of MSW management since 1999 when the EU Landfill Directive (EU Directive 99/31/EC) was introduced has seldom been investigated and assessed.

Therefore, this study attempts to investigate and assess the transition of MSW management in Nottingham, the UK by identifying the MSW flows and quantifying their global warming potential (GWP) using the tool of combined material flow analysis (MFA) and life cycle assessment (LCA). Three historical MSW management situations in 2001/02, 2006/07 and 2016/17 at three transitional stages in Nottingham responding to the EU waste directives have been investigated and assessed.

The MFA results indicate that the MSW management in Nottingham underwent a transformation from a relatively simple landfill & energy from waste (EfW) model to a complex, multi-technology model. Improvements in waste reduction, material recycling, energy recovery, and landfill

prevention were observed due to the introduction of kerbside collection, material recovery facility and residual derived fuel. During the period from 2001/02 to 2016/17, annual MSW generation reduced from 123,615 tonnes to 115,170 tonnes (per capita MSW generation reduced from 463 kg to 361 kg), the landfill share reduced from 54.7% to 7.3%, but the recycling and composting share increased from 4.6% to 44.4%. These improvements resulted in a net reduction of GHG emission from 1,076.0 kg CO₂-eq./t of MSW in 2001/02 to 487.9 kg CO₂-eq./t of MSW in 2006/07, and further to 211.3 kg CO₂-eq./t of MSW in 2016/17.

However, Nottingham have not met the recycling and composting targets and MSW management system in Nottingham is still a net emitter of GHGs. Based on the results of MFA and LCA, separating food waste from incinerated waste and applying biological treatment to it, improving the energy recovery efficiency in EfW by upgrading technology and replacing composting by advanced biological treatment such as anaerobic digestion are recommended to further improve the recycling and composting rate, and to further reduce the GHG emission from MSW management in Nottingham.

3. The Typical Strategy Path Analysis on China's Recycling Policies towards the Critical Raw Materials from Spent Lithium-ion Batteries Based on Tripartite Evolutionary Game Theory

Peifan Yao (Shanghai Polytechnic University, China)

Lifen Long (Shanghai Polytechnic University, China)

Xihua Zhang (Shanghai Polytechnic University, China)

Xiaolong Song (Shanghai Polytechnic University, China)

Jingwei Wang (Shanghai Polytechnic University, China)

China has raised developing the industry of new energy vehicles (EVs) to national strategy, and thus become the world's largest electric vehicles market. Consequently, as the most crucial component of EVs, the demand for lithium-ion batteries (LIBs) is significantly increased. However, the external dependences for most of the critical raw materials

(CRMs) used for manufacturing LIBs such as Li, Ni, and Co are as high as 70%, 86%, and 90%, respectively in China. Therefore, the contradiction between the supply and demand of CRMs will be more and more prominent. Faced by huge amount of spent LIBs along with production scrap in the future, efficient and environment-friendly recovery of CRMs from them could not only avoid secondary pollution to the environment but also promote the sustainable development of the EVs industry. In view of this, the research hereby employs tripartite evolutionary game theory (EGT) involving the government, manufacturers, and consumers. Firstly, the payoff matrix is determined, and then the replicator dynamics equation for each stakeholder is calculated. Finally, the evolutionary stability strategy for the system is obtained, and the stability conditions under different scenarios are analyzed. The results indicate that the government is more willing to promote recycling policies when taxes levied are higher than the total costs. For the manufacturers, they are more likely to construct recycling networks when acquired subsidies and profits are higher than before. As far as the consumers are concerned, they are more willing to participate in recycling of spent LIBs when subsidies and earnings through official channels are higher than that of non-official channels.

4. Circular Economy Legislation and Environmental Pollution: Evidence from China's Urban Mining Pilot Base

Hongcheng Shen (Taizhou University, China)

Yi Liu (Jiangxi University of Finance and Economics, China)

Urban Mining Pilot Base (UMPB) is an important implementation of the Circular Economy Promotion Law of China. It promotes the building of a circular economy industry and environment-friendly society. This study applies time-varying difference-in-difference estimation on city-level panel data to estimate the impacts of gradually adoption of UMPB on pollution reduction of China. To avoid model dependence and distribution imbalance of control and treatment groups, Propensity Score Matching - Difference in Difference (PSM-DID) is also adopted.

The results show us, gradual adoption of UMPB among municipal cities significantly improves waste reuse and reduces pollutant emission. We use various types of data and robustness check. The impact of UMPB policy on improving China's environmental condition is positive and significant.

5. Is Pollution Haven Transfer a Poverty-Environment Trap? Evidence from Carbon Emission Embodied in Waste Import Using SDM

Yi Liu (Jiangxi University of Finance and Economics, China)

Wanyin Feng (Xiamen University, China)

This paper tests the extent to which the Environment Kuznets Curve can be explained by the migration of dirty industries. That is to investigate the relationship of pollution haven transfer and EKC, taking account of carbon emission embodied in international trade of waste. Using Spatial Durbin Model on waste carbon dioxide emission data of 28 European Union (EU) countries from 2001 to 2018, we found that there is an inverted "U" shape curve between the carbon emissions of imported wastes and economic growth in the EU. More importantly, pollution haven effect is responsible for the CO₂ emission in the low-income countries of EU, since their industrial development and FDI growth of are more likely to increase the waste carbon emission embodied in waste import. Such effects are more obverse in the low-income countries and less developed regions in the EU, confirming that there is a poverty- environment trap. worsening environmental conditions reinforced pollution haven of the low-income countries creating a vicious circle for the low-income countries in that region.

E1 Urban Sustainable Development

1. Evaluating the Scrap Trade Risk in the Belt and Road Initiative Countries

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Chao Wang (Beijing University of Technology, China)

Ming K. Lim (Chongqing University, China)

China's Belt and Road Initiative (BRI) is a global development strategy, representing great potentials for multilateral trade cooperation and economic growth in Asia, Europe and Africa. The trade volume of commodities along the BRI countries booms in the last few years. The commodities trade attracts extensive attention worldwide, but the scrap trade received little attention. To fill this gap, this study reviews the scrap trade network and evaluates the potential scrap trade risks in the BRI countries including political, social, and economic risks.

First, this study constructs the scrap trade networks among the BRI countries from 1989 to 2018. Second, the synopsis of the scrap trade network is reviewed. Third, the risk evaluation models are built to analyze the impact of the trade relationships on the vulnerability. Finally, the policy implications are provided to promote scrap trade collaboration among the BRI countries. This study is valuable because it is the first time to identify the scrap trade risk among the BRI countries. It will support policy-makers to build an effective collaboration mechanism to alleviate resource shortage and tackle the global scrap crisis.

2. Resource-Based Contraction Cities in China: From Shrinking Characteristics to Influencing Factors Correlation

Jing Wei (China University of Geosciences, China)

Jianjun Zhang (China University of Geosciences, China)

As a special type of city in the process of urbanization, the sustainable development of resource-based contraction city deserves worldwide attention. Urban development is not always expanding, and contraction is regarded as an objective and normal state of urban development as well. Urban shrinkage is not a short-term interruption of expansion, but an unavoidable global structural phenomenon and inevitable reflection of the competition among population, economy and ecology within the city in the new era. For nearly half a century, the shrinking phenomenon of cities has

spread rapidly on a global scale, and it is bound to become a crucial issue facing the sustainable development of cities all over the world in the future. However, resource-based cities have a significant impact on the level of urban comprehensive shrinkage, with a significantly higher proportion of shrinkage than that of non-resource-based cities. Therefore, they are cities with the necessity and urgency of typical space reshaping.

Resource-based cities play a vital role in China's economic development. However, owing to the slowdown in economic growth, single industrial structure, and boom-and-bust industrial cycle, they are also facing the severe challenge of urban shrinkage. This study focuses on the shrinking phenomenon of resource-based cities, and selects national resource-based cities as the research area to reveal the shrinking characteristics in China. and using the Pearson correlation coefficient to explore the relevant factors correlation contributing to urban shrinkage. The expected results and findings are as follows. First, urban shrinkage of resource-based cities is characterized by the loss of population, accompanying by the decline of urban economic level and social quality, and the shrinking features and process of cities are various. Second, cities with different types of resources are in diverse stages of contraction, and the cities that depend on the development of non-renewable resources have more obvious contraction features, such as coal mining cities. Third, resource depletion is the main factor leading to the contraction of resource-based cities, followed by population and industrial structure. Fourth, corresponding measures, such as changing the concept and mode of urban development and formulating new development plans to cope with the shrinking phenomenon, coordinating the relationship between the strength of resources development and economic benefits, cultivating alternative industries to promote urban transformation and upgrading, and making differentiated policies according to the actual development of cities rather than "one-size-fits-all", are supposed to be taken to promote the sustainable development of such cities.

Compared with urban expansion, it is more complicated and difficult for urban management in a

shrinking state. Therefore, it is of great significance to fully grasp the causes, processes and forms of the contraction of resource-based cities for the future sustainable urban development strategy. Our study is helpful to provide a certain theoretical basis and practical value for the sustainable development of resource-based contraction cities in China and other countries with similar situations.

3. Resource Efficiency Research of Ionic Rare Earth based on the Material Flow Analysis-Taking Ganzhou, Jiangxi as an Example

Chen Wan (Jiangxi University of Science and Technology, China)

Dan Zhou (Jiangxi University of Science and Technology, China)

Bing Xue (Jiangxi University of Science and Technology, China)

Ionic rare earth is a significant resource. Ganzhou city of Jiangxi province is the world's largest supply base of ionic rare earth (RE) resources. In the past few decades, the disorder and excessive development and utilization of ionic RE resources in China have caused serious environmental problems and restricted the healthy development of ionic rare earth industry. The development and utilization of ionic RE is closely related to the national economic development and industrialization process. A comprehensive understanding of its flow is the basis of efficient utilization and rational protection of ionic RE resources. In order to reduce the damage of ionic RE resources development and utilization process on the mining area and the surrounding ecological environment of enterprises, and improve the resource utilization efficiency, this paper takes the flow of rare earth resources in Ganzhou City as an example, and constructs the material flow analysis model of ionic rare earth industry ecosystem in Ganzhou City by using the material flow analysis method. Through model analysis, this paper evaluates the RE resource efficiency of Ganzhou City from 2006 to 2019 since the implementation of the mandatory plan of RE ore production in China. The ore resources, recycling efficiency, waste index and environmental impact in the process of raw ore mining and smelting separation were quantitatively

analyzed and evaluated at this paper. The specific production process and process characteristics of typical rare earth smelting and separation enterprises in Ganzhou City are analyzed, and the key links of resource utilization, energy utilization and pollution generation in the production process of main rare earth products are put forward. Finally, the relevant environmental management measures were put forward from the aspects of improving resource utilization efficiency, optimizing product structure and recycling system, which provided theoretical support for the green development and utilization of ionic RE resources and the sustainable development of the industry.

4. Policy Impact for Construction Waste Management in Yangtze River Delta Region

Shiwang Yu (Xi'an Jiaotong-Liverpool University, China)

Jianli Hao (Xi'an Jiaotong-Liverpool University, China)

Yu Song (Xi'an Jiaotong-Liverpool University, China)

Conghua Wen (Xi'an Jiaotong-Liverpool University, China)

Mingkang Wen (Sanjiang University, China)

The dramatically growing amount of construction waste (CW) in China over the last few decades has brought about great environmental and social pressure. High performance of construction waste management (CWM) has a bearing on sustainable economic development and the implementation of "the 13th Five-Year Plan". To encourage CW reducing, recycling, and landfilling, government policies (GP) regarding CWM have been released and implemented in different cities. However, little empirical evidence is known so far about the effectiveness of the GP on CW. Accurate understanding of the impacts of the GP on CWM can serve as a valuable reference for preparing "the 14th Five-Year Plan". As one of the most developed regions in China, the Yangtze River Delta (YRD) region produces a large amount of CW every year. Investigating the GP and CWM in the YRD region can be conducive not only to formulating the development strategy of the low-carbon and circular economy as well as waste sorting but also to promoting the development of the integration of the

YRD region. This study aims to investigate the effectiveness of the GP on the CWM in the three capital cities in the YRD region of China, namely, Nanjing, Shanghai, and Hangzhou.

The desk research method was employed in this study. Governmental policies on CWM released by the three cities were collected from the relevant official websites and quantities of CW produced in three cities were calculated based on the data retrieved from the 2007-2018 Statistical Yearbooks and official websites. A comparative study was then employed to compare the impacts of GP on CWM in the three cities. A series of tables and statistic graphs were made to visualize the variation of the CW quantities and their interaction with the GP. Policy evaluation was then conducted to examine the effectiveness of the GP on the CWM in the three cities.

The findings of the research are as follows: (1) the gyrating-up trend of the CW output is found in all three cities; (2) the GP on CWM in Shanghai is more effective than the other two cities; (3) the effectiveness of GP gradually declines over time.

Based on the findings of this research, several implications need to be considered: (1) PG need to be jointly made by collaborating administrative departments; (2) cooperation between different administrative departments should be substantial rather than being formalistic; (3) detailed data about the CW (generation, landfilling, and recycling) need to be released at least annually by the statistical bureau; and (4) a web monitoring platform is recommended to be established in each city to record and monitor the whole process of CWM.

■ E2 Communication and Technologies

1. “I Buy Green Products for My Benefits or Yours”: Understanding Consumer’s Intention to Purchase Green Products

Ying Sun (Beijing Technology and Business University)

Nowadays, the role of purchasing green products to reduce consumer’s impact on the environment has received a great deal of attention. However, consumers choose green products not only for the environmental impact of products but also for their domestic interests. This research aims to conduct a comprehensive conceptual model and empirical validation of the integration of negative (ego-centric) and positive (altruistic and ego-centric) drivers of green buying based on social dilemma theory and psychological egoism theory. The results indicate that moral obligations, green self-identity, environmental concern, and social pressure are positively, while perceived cost of green purchasing and price sensitivity are negatively related to green purchase intention. Meanwhile, social pressure positively moderates the relationship between green self-identity and green purchase intention and the relationship between price sensitivity and green purchase intention, but negative moderate the relationship between environmental concern and consumers’ green purchasing intention. The study discusses the policy implications and suggestions for further research based on these results.

2. CCUS Technology and Hydrogen Industry Integrated Development

Lingyun Zhang (University of Nottingham Ningbo China)

Climate change is a global issue that affected all countries’ social, economic development, and ecological environment. To realize the sustainable development of human society, governments worldwide are making efforts to slow down global warming and reduce greenhouse gas emissions. CCUS (Carbon capture, utilisation and storage) is an essential emissions reduction technology, and it is believed to achieve near-zero emissions from fossil energy. Hydrogen is a versatile energy carrier and can help to improve air quality and energy security. However, today’s most hydrogen is made from fossil fuels, with significant associated CO₂ emissions. This study integrated CCUS technology and the hydrogen industry to reduce carbon emissions and discussed the feasibility of coupling development from the policy perspective, technical level, and coupling

process roadmap. The results show that CO₂ enhanced oil recovery (CO₂-EOR) and CO₂ enhanced coalbed methane recovery (CO₂-ECBM) are promising CCUS technologies. The clean hydrogen from electrolysis of water and fossil fuels with CCUS is the ultimate development route. From the technical view, this study proposed the coupling technical route of CCUS+SMR (Steam methane reforming), CCUS+coal-to-hydrogen, and the large-scale utilisation of CO₂ is realised through the CO₂ integration center. But these processes also face considerable challenges, the main obstacle being the economy, which requires strong support from the national policies and further promotes carbon taxes and standardization of the carbon market.

3. Comprehensive Evaluation of Urbanization Development Quality in Fujian Province

Yaping Zhang (China University of Geosciences)

Urbanization is an important yardstick to measure the development level of a country and it's related to the economy, population, ecology, etc. The high economic and ecological level of coastal areas is the guarantee for the smooth construction of The Maritime Silk Road. Fujian Province, as the starting point of The Maritime Silk Road, which is China's maritime hub connecting the Asia-Pacific economic circle and the European economic circle, its urbanization development level plays a significant role in the sustainable development of Fujian Province and the construction of the Belt and Road. Taking 9 cities in Fujian Province as the study area, based on the statistical data from 2008 to 2018, the evaluation system is constructed from three aspects including social urbanization, economic urbanization and ecological urbanization. And the entropy weight method is used to determine the weight of indexes to analyze the urbanization level in Fujian Province. Furthermore, the spatial autocorrelation characteristics of urbanization development levels in different areas is discussed. The results show that: (1) The urbanization development level of Fujian Province from 2008 to 2018 shows a significantly upward trend. (2)The spatial and temporal differences in the quality of urbanization

development in Fujian Province are obvious. (3) Fuzhou, Quanzhou, and Xiamen have relatively high levels of urbanization, with obvious geographical advantages. The establishment of the Fuzhou Metropolitan and the Xiamen-Zhangzhou-Quanzhou Metropolitan has improved the level of regional urbanization obviously. (4) The quality of urbanization development in Fujian Province shows a significant positive spatial correlation. The areas with low quality of urbanization development are mainly concentrated in inland mountainous areas. And areas with high levels of urbanization are mainly concentrated in coastal cities. In the future, Fujian Province is supposed to appropriate urbanization promotion strategies based on the actual development of cities, like expanding exchanges and cooperation between regions, promoting the flow of production factors between cities and increasing investment in technology and education. Meanwhile, Fujian Province should strengthen policy support for the western mountainous areas, and narrow the quality gap between the eastern coastal areas and the western urbanization development. Under the background of The Belt and Road, Fuzhou Metropolitan and the Xiamen-Zhangzhou-Quanzhou Metropolitan should be the engine to further accelerate the development of underdeveloped areas and form a good pattern of coordinated advancement and overall development. Our study provides significant references for optimizing the spatial structure and improving sustainable urbanization level in Fujian.

■ E3

Waste Management

1. Optimal Rectangle Packing to Minimize Wastage

Shijun Chen (Hubei University of Arts and Science, China)

Jiying Xu (Hubei University of Arts and Science, China)

Aiyang Rong (Hubei University of Arts and Science, China)

Weigang Zhou (Hubei University of Arts and Science, China)

To mitigate the contradiction between resource shortage and population growth, it is important to promote resource conservation and environment protection across the manufacturing sectors because the manufacturing is the pillar industry for any industrialized countries. Conservation (saving) type economy is one of options for transition into future sustainable economy.

Cutting and packing problem is one of widely studied problems in different manufacturing sectors such as metal, paper, glass and cloth cutting and processing. The objective of the problem is more or less the same or similar in different industrial settings: to produce the good quality arrangement of items on the stock sheet in order to maximize raw material utilization or minimize the wastage. However, it is an NP-hard problem from the viewpoints of operations research and computer science. That is, the computational time for solving the problem increases exponentially as the size of problem increases. Consequently, the traditional exact algorithm is difficult to handle large-scale problem due to extremely large solution time and the existing heuristics may produce the solution with a larger waste area in the stock sheet and result in the wastage of valuable raw material.

Here, we address the problem of placing rectangles of different sizes into a larger regular sheet to maximize the sheet utilization. We tried to develop an improved two-stage packing algorithm to get a good utilization rate of the raw materials. At the first stage, an improved bottom-left fill (BLF) algorithm is presented to fill the left-top corner of the big rectangle. Then the rectangular pieces are encoded in the sequence of placing, the proposed improved BLF algorithm is used for decoding, and a neighborhood search algorithm is designed to find the optimal solution. Numerical experiments showed that the new algorithm can achieve nearly 100 % utilization rate and increase by 11% as compared with the traditional BLF algorithm.

2. Development of Sustainable Concrete by Optimization of Aggregate Packing and Cement Paste Volume

Yuan Jiang (University of Nottingham Ningbo China)

Bo Li (University of Nottingham Ningbo China)

With the rapid urbanization and industrialization in China, a large amount of construction and demolition (C&D) wastes have been produced in the past decades. Due to the shortage of the dumping spaces, some of the C&D wastes were disposed into unauthorised landfill sites, leading to a negative effect on the environment. Moreover, increasing demand of natural aggregates for new concrete production has also brought a tremendous pressure on the environment. For the sake of a balance between the social development and environment, one of the commonly used methods is to recycle the aggregates in the C&D wastes as the raw material for recycled aggregate concrete (RAC). The intrinsic inferiority of recycled concrete aggregate (RCA) restrains the replacement ratio of natural aggregates by up to 30% in the RAC without compromising the mechanical properties. However, the prerequisite for guaranteeing the performance of RAC is not only dependent on the quality and the quantity of RCA but also be closely related to the aggregate packing status. On the other hand, cement is a habitual construction material used as the binder in the concrete production. The cement industry contributes a tremendous greenhouse gas (GHG) emission, which accounts for almost 8% of the global GHG emission. The reduction of cement usage has been recognized as one of the strategies for sustainable construction. The cement paste volume (CPV) can be used to quantify the cement content in a given bulk volume of concrete. However, limited studies have attempted to unveil the role of CPV in concrete performance, especially for RAC. Therefore, this paper investigates the influence of aggregate packing optimization based on a particle packing method (PPM) and CPV on the workability and mechanical properties of both natural aggregate concrete (NAC) and RAC. The results indicate that the use of PPM can help to densify the granular skeleton of aggregates in concrete by reducing the void around the aggregates and the cement paste film thickness, and subsequently enhance the mechanical properties of the NAC and RAC with a constant CPV. This enhancement is higher for RAC than NAC, particularly for the Young modulus. The properties of PPM designed RAC are consequently comparable

with that of NAC. Moreover, increasing CPV in concrete with a maximum aggregate packing density considerably decreases the mechanical properties of concrete, whereas increases its workability. Therefore, the overall performance of concrete with a full replacement of natural aggregates with RCA could be enhanced by a dense aggregate skeleton with particle packing optimization. The relatively low CPV is also recommended for the RAC mix design for enhancing the mechanical properties and reducing the cement content.

3. Effects of Climate and Landfill Characteristics on Leachate Physicochemical Properties from a Global Perspective

Shijun Ma (Research Center for Eco-Environmental Sciences, China)

Chuanbin Zhou (Research Center for Eco-Environmental Sciences, China)

Guang Yang (Research Center for Eco-Environmental Sciences, China)

Leachate leakage is one of the most crucial environmental pollution in landfill sites. However, for the concentration range of landfill leachate pollutants with landfill ages, data in different regions were insufficient. In this paper, we analyzed the correlation between typical leachate pollutants (COD, BOD₅, ammonia nitrogen, SO₄²⁻, Cl⁻, K⁺, Cd, Cr, Fe, Ni, Pb) and critical influencing factors (temperature, precipitation, landfill age and waste compositions) using data from published literature and reports. Then arithmetic mean value and standard deviation were applied to coarsely summarize the typical pollutants in landfills by country type, climate zone and landfill age. Results showed that: (1) food waste, one of the most important impact factors for all degradable organic matter and inorganic macro components, has a positive correlation with typical landfill leachate pollutants, while R² and r value are 0.05-0.19 and 0.25-0.44, respectively; (2) There is no significant correlation between heavy metals and all influencing factors; (3) Landfill leachate in developing countries at the dry temperature area had high concentration of pollutants. This study could provide reference for

the treatment of regional typical leachate pollutants, and also provide important parameters for future research on the ecological environmental risks brought by leachate pollutants in regional, national and global landfill sites.

4. EKC of CO₂ Embodied in International Waste Import: Evidence from 134 Countries

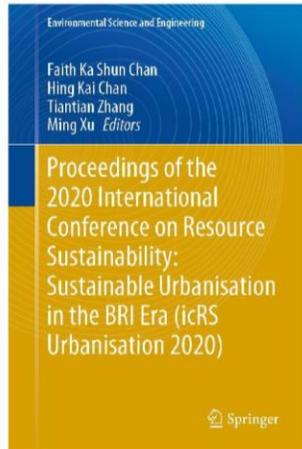
Yi Liu (Jiangxi University of Finance and Economics, China)

Xueqi Shi (Jiangxi University of Finance and Economics, China)

Waste trade has benefited both trading countries. It not only reduced the pressures of waste disposal of in the developed countries, but also mitigates the world resource scarcity. However, in the process of waste trade, there are environmental costs that is not considered. The environmental problems caused by waste import have become increasingly prominent. Many countries choose to prohibit the import of certain wastes and gradually close the “door” of waste import. Does this mean that the Kuznets curve inflection point of carbon emissions from waste trade in these countries has arrived? In this paper, using the product life cycle method, we calculate the energy consumption and carbon dioxide emission embodied in a variety of important imported resource-based wastes in 134 waste importing countries from 2001 to 2018. The relationship between the energy consumption (carbon dioxide emissions embodied), and economic growth of 134 countries is studied. The relationship between energy consumption, carbon dioxide emission and economic growth does have an inverted U-shaped curve (EKC). Further empirical results show that: (1) the embodied energy and carbon dioxide emissions from imported wastes are significantly positively correlated with the total population, trade openness and urbanization of a country; (2) the inflection points of the EKC on the average embodied energy and carbon dioxide emissions of imported wastes are 37181.3 and 36623.88 USD respectively; (3) EKC appears in 68 countries out of 134 countries. Most of these 68 countries have crossed the turning point. It implies that as the economy grows further, it is possible to

reduce the environmental pollution caused by the waste trade.

Conference Proceedings



F.K.S. Chan, H.K. Chan, T. Zhang, M. Xu (Eds.)

Proceedings of the 2020 International Conference on Resource Sustainability: Sustainable Urbanisation in the BRI Era (icRS Urbanisation 2020)

Series: Environmental Science and Engineering

1st ed. 2020, VIII, 469 p. 143 illus., 105 illus. in color.

Printed book

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- Shares many insights into the link between the Industrial Management and the Ecology

This book focuses on the latest cutting-edge research for achieving sustainable development goals during urbanisation in the Belt and Road Initiative Era. The book aims on tackling urban challenges on social and environmental issues. The book is a compilation of selected papers from the 2020 International Conference on Resource Sustainability – Sustainable Urbanisation in the BRI Era (icRS Urbanisation 2020). The contents make valuable contributions to academic researchers, practitioners in the industry and policymakers of respective authorities. Readers will also encounter new ideas for realising a better sustainable development for urbanisation.



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Part of **SPRINGER NATURE**

Post-Conference Tour

XIKOU AND XUEDOU MOUNTAIN ONE DAY TRIP

15th December, Tuesday

1. Tour Description

In the west of Ningbo city, there is a famous and charming town named Xikou, which has a long history, graceful mountains, deep cultural foundations and rich tourism resources. Xikou, surrounded by mountains and rivers, is to the east of Wuling Ridge, to the south of the Shan Stream and to the north of Xuedou Mountain. It covers 381 square kilometers, and is regarded as the legendary “Xanadu”. Besides, Xikou has been labelled as National Park of China and National AAAAA Level Tourist Area.

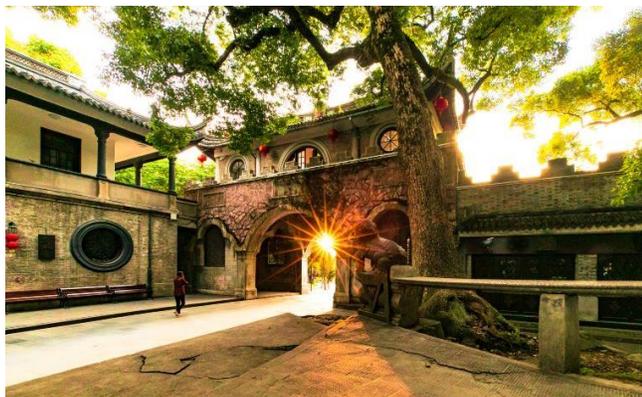


Xikou is the hometown of Mr. Chiang Kai Shek and Mr. Chiang Ching Kuo. Fenghao House, the ancestral tombs, temples and home convent are well protected, which can be regarded as the typical representation of the culture of the Republic of China. With picturesque natural scenery and numbers of historic figures, Xikou enjoys the harmony of landscape, cultural interest and buddhism site. Xuedou Mountain, which is one of the fifth-famous Chinese Buddhist Mountains, is the only national scenic spot in Ningbo City. Xuedou Temple, which is titled as one of the ten Chan Sect temples in

the world, is considered as the Daochang (home of Buddha) of Maitreya Buddha. Newly built Maitreya is 56.7 meters high, which is the tallest sitting posture copper image and exquisite item of Buddhism culture.

2. Tentative Tour Scheduling

8:00	Get together in the morning and drive to Xikou
	WuLing Gate - Chiang Kai Shek and Soong Mei Ling's Bridal cottage The reading place of Chiang Ching Kuo, named Small House
9:30-11:30	Chiang's former residence - FengHao Room Chiang Kai Shek's birthplace (Chiang ancestral residence) - Yutai Salt Stall Xikou Museum - Xikou local conditions, customs and cultural relics
11:30-12:30	Have Lunch Xuedou Mountain Scenic Area
12:30-15:30	Giant Buddha Scenic Area: The millennium Ancient temple of Maitreya Ashram, General Nan, The Open-air Maitreya Buddha Sanli Old Street free activities time.
15:30	Return to Ningbo



3. Booking and Payment

The tour is managed by Zhejiang Feiyang Travel Agency.

Price: about 400 Yuan/person (including air-conditioned tour bus, one standard lunch, tickets for Xikou scenic area and Xuedou Temple, and a fulltime accompany guide).

The payment will be collected on the site of the registration (December 12th and December 13th).

Any excess payment shall be refunded. The tour is intended for a minimum of 17 participants. In case this minimum number is not reached, registered participants will be refunded.

To join the tour please sent the name and contact number to Jia Luo at jia.luo2@nottingham.edu.cn. Should you have any inquiry about this tour please feel free to contact us.

General Information

CONFERENCE LANGUAGE

The official language of this conference is English. All speeches, presentation and relevant materials are all in English

PROGRAM SCHEDULE

The program is arranged chronologically by date and time of the activity. Papers and rooms are indicated.

To read abstracts or download papers, please consult our [conference website](#).

PRESENTATION INFORMATION

Each submission will be given 20 minutes for presentation in the parallel session (including Q&A).

Computers and projectors will be provided.

OPENING HOURS OF REGISTRATION AND HELP DESK

- Saturday: 17:30–19:30
(at Welcome Reception)
- Sunday: 8:30–18:00 (Library)
- Monday: 8:30–17:00 (Library)
- Tuesday: 8:00–12:30 (Library)

FIRST AID ASSISTANCE

If first aid is required, please inform a member of the staff immediately or call 120.

ADMISSION POLICY

- The conference is open to registered attendees only.
- Participants registered to social events are requested to show their tickets.

Attendees who are unable to show their tickets for the Conference Dinner cannot be granted access.

- All attendees are required to wear their badges at all times.
- Anyone attending the icRS Urbanisation 2020 should not participate in canvassing, demonstrating, engaging in inappropriate behavior, or any other activity that may disrupt the icRS Urbanisation 2020.
- The organizers reserve the right to exclude or remove anyone, who breaks or is viewed as likely to break these rules from the icRS Urbanisation 2020.

COMPANIONS

Accompanying guests are welcome to participate in social events, given previous registration. They will be asked to show their tickets.

LOST & FOUND

The lost and found is located at the help desk.

Conference Venue

University of Nottingham Ningbo China 宁波诺丁汉大学

The University of Nottingham Ningbo China (UNNC) is the first Sino-foreign university to open its doors in China. Established in 2004, with the full approval of the Chinese Ministry of Education, we are run by the University of Nottingham with co-operation from Zhejiang Wanli Education Group, a key player in the education sector in China. Academic standards and the quality of the student learning experience at UNNC is equivalent to those of the University of Nottingham UK. The University of Nottingham ranked as a world top 100 university by QS World University Ranking 2020.

The University is located at the heart of Yinzhou Distinction, Ningbo City. Situated on a 144-acre site, UNNC offers unique opportunities for students and provides as fully a British education as a possible in China. UNNC has around 8,000 students and approximately 10% are from Hong Kong, Macao, Taiwan and overseas countries. There are around 880 members of staff, splits across academic and professional services. Staff and students come from more than 70 countries and regions around the world.

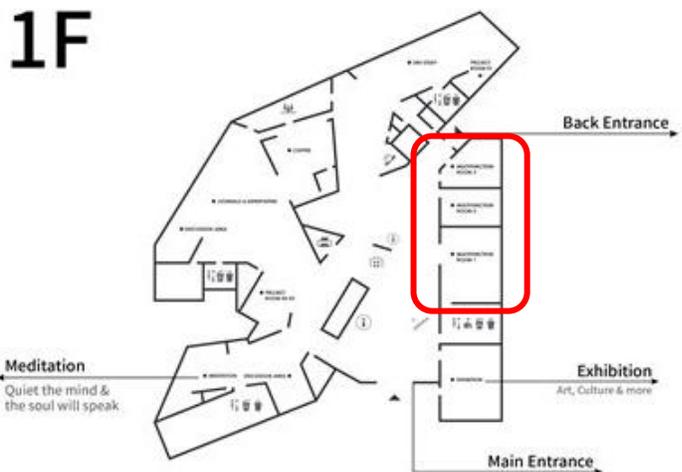


Li Dak Sum-Yip Yio Chin-Kenneth Li Library

The brand new library building, covering an area of 7,500m², is located at the heart of the campus. The designed floor area is 24,832 m² in total. The construction commences in June 2018 and completes in 2020.

- Comprehensive and integrated space for learning, teaching and researchers.
- Extensive resources, world-class technologies and welcoming environment.
- Cultural gravity presenting heritage, advance and excellence.

The main venue for the icRS Urbanisation 2020 is the Multi-function Room located at 1F of the new library.



UNNC Campus Access Guide

Due to COVID-19, UNNC only accepts visitors with entry permit. This guide provides essential information for entering the campus:

NOTE: Visitors can only enter the campus from Gate 1. If you take a taxi to the campus, please let the taxi driver know the gate number.

1. Before arrival

Registered participants will receive a confirmation message about your scheduled visit to UNNC as below:

【UNNC Visitor】 Dear XXX, you've been scheduled for a visit to UNNC on 2020-12-08. Please view details via: <https://visitor.nottingham.edu.cn/visitEN/5331882789?t=>

Please save the message and the link. If you do not received the confirmation message before 12th December, please contact Jessie Chen at ying.chen@nottingham.edu.cn as soon as possible.

2. When arrival

Please click the link in the message and you will be brought to the QR code (see example below):



When you arrive at Gate 1 on the scheduled date, please show the QR code and your ID card to the security guards.



Transportation

CAR

Hangzhou-Ningbo Express Way G92/S

- After passing the Dazhujia tollgate turn right onto Qianhu North Road. Drive 4km south before turning left onto Taikang East Road. The University is on the right.

Ningbo Ring Road G1501

- After passing the Yunlong toll gate turn left onto Yinzhou Avenue and drive 3.5km west. Turn right onto Qianhu South Road before turning right onto Taikang East Road. The campus is on the right.

PLANE

From Ningbo Lishe Airport

- A taxi from the airport costs around 30 RMB for a 12km journey.

From Hangzhou Xiaoshan Airport

- Take the shuttle bus from the airport to Hangzhou Train Station then get the high-speed train to Ningbo Train Station.

From Shanghai Hongqiao Airport

- Transfer by Metro/foot to Hongqiao Train Station then get the high-speed train to Ningbo Train Station.

From Shanghai Pudong Airport

- Take a taxi or the Metro to Hongqiao Train Station, then take the high speed train to Ningbo. A taxi to Hongqiao Train Station will take about one hour and costs around 250 RMB. To get to Hongqiao Train Station via Metro, take Line 2 and transfer at Guanglan Lu station.

COACH

A taxi from Ningbo Central Coach Station costs around 30 RMB for an 11km journey. Buses 115, 132, and 368 run from the coach station and stop near campus.

TRAIN

The easiest way to get to the University from Ningbo Train Station is by taxi. The fare is around 30 RMB for an 11km journey. Buses 159, 161 and 369 run from the station and stop near campus.

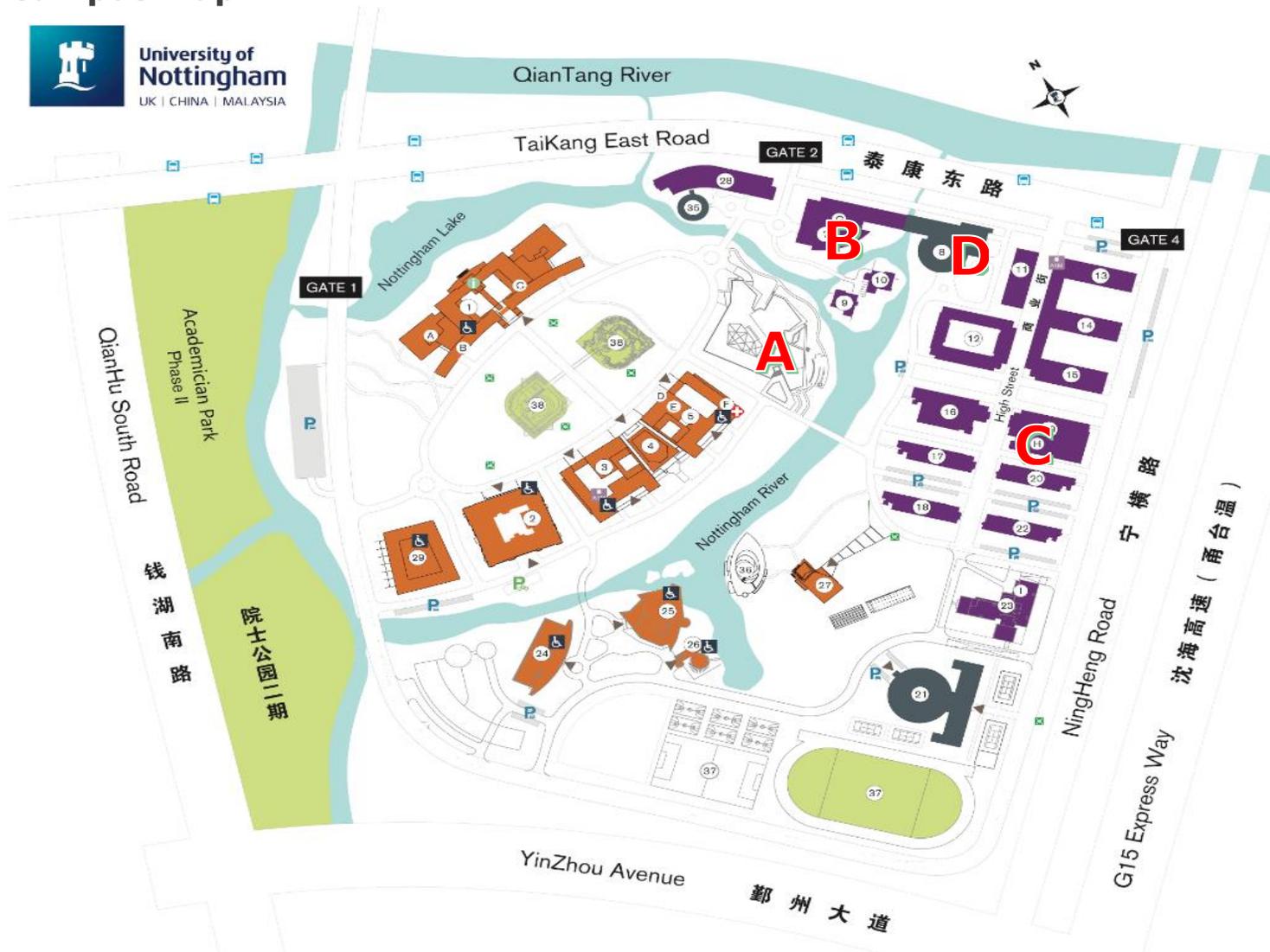
TAXI

Show taxi drivers the following address to reach the University campus:

宁波市鄞州区高教园区泰康东路 199 号 宁波诺丁汉大学 1 号门

199 Taikang East Road, Ningbo

Campus Map



	Fire assembly point	紧急疏散集合点
	Building entrances	建筑入口
	Clinic	诊所
	Reception	问讯处
	ATM	取款机
	Accessible Toilet	无障碍卫生间
	Bus stop	公交车站
	Bicycle parking	自行车停放处
	Car parking	机动车停车场
	Academic buildings	教学办公建筑
	Residences	宿舍公寓
	Other services	其他服务

Trant Building (TRENT)	行政楼	1
Library	图书馆	A
Admissions and Career Development Office	招生就业办公室	B
Arabica Restaurant	阿兰姆卡餐厅	C
The Sir Peter Mansfield Building (PMB)	理工楼	2
Teaching Building (TB)	教学楼	3
Auditorium	思源报告厅	4
The Portland Building (PB)	学生事务楼	5
Starbucks Coffee Shop	星巴克咖啡	D
The Hub	学生一站式服务中心	E
Clinic	医务室	F
Staff Hotel	教工宾馆	7
Robin Hood Restaurant	罗宾汉餐厅	G
Student Canteen	学生餐厅	8
Villas	别墅	9,10
Student Residences	学生宿舍	11-20, 22
Halal Canteen	清真餐厅	H
Sir Colin Campbell Building (Sports Centre)	体育馆	21
Residence	宿舍楼	23
Residential College	学生事务中心	I
The Lord Dearing Building (DB)	新教学楼	24
The D.H. Lawrence Auditorium	新报告厅	25
New International Conference Centre	新国际会议中心	26
Centre for Sustainable Energy Technologies (CSET)	可持续能源技术研究中心	27
Staff Apartments	教师公寓	28
Sir David and Lady Susan Greensaway Building	海洋经济研究院	29
International Conference Centre (ICC)	国际会议中心	35
Music Plaza	小广场	36
Outdoor Sports Facilities	室外运动场地	37
Ornamental Gardens	公园	38

A – Li Dak Sum-Yip Yio Chin-Kenneth Li Library (Main conference venue) ; B – LA hotel;

C – Student Residential/ Canteen area; D –MN Restaurant

Accommodation

Ningbo offers many options for all budgets. Booking can be done via the hotel website or travel agency platforms. We recommend the following:

1. The Liberal Arts Hotel (on-campus) 博雅酒店 (校内)

- Address: on campus
- Single room at 305RMB per night, twin room at 330RMB per night (breakfast included)
- For reservations, please email Jia LUO (jia.luo2@nottingham.edu.cn)

2. Tianwei Art Hotel 宁波天唯艺术酒店

- Address: 697 Xueshi Road
- Transportation: 1.1 kilometers from the conference venue; 3 mins by taxi
- Tel: +86-574-81009999.
- Details of the hotel: [click here.](#)

3. Sofitel Wanda Ningbo Hotel 宁波万达索菲特大酒店

- Address: 899 Middle Siming Road
- Transportation: 5.0 kilometers from the conference venue; 12 mins by taxi; bus routes: 161, 363, 111 and 118
- Tel: +86-574-28899888
- Details of the hotel: [click here.](#)

4. Nanyuan New Town Hotel 南苑新城大酒店

- Address: 667 Middle Taikang Road
- Transportation: 2.5 kilometers from the conference venue; 5 mins by taxiTel: +86-574-89066999
- Details of the hotel: [click here.](#)

5. New Century Grand Hotel 开元名都大酒店

- Address: 666 Middle Shounan Road
- Transportation: 2.7 kilometers from the conference venue; 5 mins by taxi
- Tel: +86-574-83078888

- Details of the hotel: [click here.](#)

6. Nanyuan Universe Deluxe Hotel 南苑环球大酒店

- Address: 1288 Yinxian Avenue
- Transportation: 3.7 kilometres from the conference venue; 10 mins by taxi; bus routes: 161, 177, 115, 118, 368
- Tel: +86-574-82809999
- Details of the hotel: [click here.](#)

7. Atour Hotel 亚朵酒店

- Address: No.268 Dieyuan Road
- Transportation: 1.8 km from the conference venue; 5mins by taxi
- Tel: +86-574-88133555
- Details of the hotel: [click here.](#)

8. Hilton Garden Inn 希尔顿花园

- Address: 1099 Yinzhou Avenue
- Transportation: 1.5 km from the conference venue; 5mins by taxi
- Tel: +86-574-28936666
- Details of the hotel: [click here.](#)

9. Vienna International Hotel 维也纳国际酒店

- Address: 229 Tai'an Middle Road
- Transportation: 1.3 km from the conference venue; 5 mins by taxi
- Tel: +86-574-88184888
- Details of the hotel: [click here.](#)

10. Mochi Boutique Hotel 墨憩酒店

- Address: 1 Nanbu Business Zone
- Transportation: 1.7 km from the conference venue; 5mins by taxi
- Tel: +86-574-28880000
- Details of the hotel: [click here.](#)

List of Participants

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- Dr. Faith Chan faith.chan@nottingham.edu.cn

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