主辦單位：

HKIE THE HONG KONG INSTITUTION OF ENGINEERS 香港工程師學會

廣東省科學技術協會
Guangdong Provincial Association For Science and Technology

澳門工程師學會
Associação dos Engenheiros de Macau
The Macau Institution of Engineers

第八屆粵港澳可持續發展研討會

The 8th Guangdong Hong Kong Macau Sustainable Development Conference

一帶一路下大灣區
可持續發展機遇與挑戰

Opportunities and Challenges of Sustainable Development in the Pearl River Delta Bay Area under the Belt and Road Initiative

建構可持續城市

憑藉專業知識及豐富經驗，保華建業屹立香港建造及工程界七十年。一直以來，保華建業參與及建設不少具挑戰性及代表性的項目，為香港以及世界各地的城市勾劃和塑造出深刻和具標誌性的景觀，點綴各大都會。與此同時，保華建業矢志把可持續發展融入建築中，與客戶及持分者共同創建環保和諧的社區。

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粵港澳可持續發展研討會成立於二零零二年，由廣東省、香港以及澳門三地的資深工程師組成的委員會合力主辦。粵港澳三地一直有緊密的關係，自創辦以來，已成功舉辦了七屆，得到了粵港澳工程界、科技界乃至社會各界的廣泛認同和大力支持，加強粵港澳的交流與合作作出了積極貢獻。

是次第八屆會議由香港承辦；承辦單位分別是香港工程師學會的環境分部及土木分部。而合辦單位為廣東省科學技術協會及澳門工程師學會。會議將以創新發展、協調發展、開放發展、綠色發展及共享發展為大方向；經濟活力，環境可持續性和社會和諧為大灣區可持續發展三個平衡目標，以七大範疇作為討論重點，包括: 一帶一路大灣區未來發展趨勢及思路；珠江三角州在十三五計劃的未來發展路向；世界國際于大灣區發展與機遇；可持續發展總體規劃及挑戰；各地面對的可持續發展和合作機遇與戰略；可持續的經濟發展、交通、物流、訊息／智慧城市、人流、環境及綠色發展(空氣，水，綠色建築)、能源供應及使用；及氣候變化的機遇與挑戰、社會文化發展以及邁向可持續國際化的標準與管理。

目前「一帶一路」倡議雖然尚處於起步階段，許多細節仍需逐步落實，但業界將鼎力聯同香港特區政府攜手配合國家發展。香港工程師學會的環境分部及土木分部希望提升「一帶一路」沿線國家在大型基礎的建設，未來將有大量大型的基建工程，包括鐵路、公路和港口等，均會採用鄰近或西方先進國家的標準，並提高環境管理水平。而香港工程界可以為「一帶一路」沿線地區提供顧問服務和參與建設營運管理，帶動高端服務業的需求，同時推動綠色發展與綠色生活。

而廣東省則希望藉著透過一帶一路下加速“粵港澳大灣區”的發展，提高資源跨區域配置效率，建立更緊密粵港澳合作關係的重要戰略。一方面旨在提升區域經濟增長的可持續能力和輻射帶動能力，打造粵港澳大灣區，另一方面也是為了加強“一帶一路”戰略，以大灣區建設為支點，打造「陸海內外聯動、東西雙向開放」的全面開放新格局。

澳門地區方面，澳門特區政府亦致力發揮聯繫中國與葡語國家的平台作用，加強及促進中國、葡語系國家和澳門的共同發展。為了支持澳門產業結構適度多元化發展，中國內地也同意投放在會展業上的合作，藉此加強雙方之間的工業合作及推動本地產業。此外，內地亦全力支持和配合澳門舉辦大型國際會議和展覽會。有見及此，澳門工程師學會亦不遺餘力，全力推動與工程專業相關的會議及展覽項目。澳門工程師學會冀成為一個葡語工程師平台，以加強彼此的恆常交流，並加以推動中國與葡語系國家之間的經濟及文化發展。

「一帶一路」沿線六十多個國家以新興經濟體為主，與粵港澳三地的互補性很強，我們期望透過是次研討會，使三地的精英互相交流合作，促進行業的發展，滿足社會，經濟、環保和可持續發展的需要，為將來可持續發展機遇與挑戰作出準備。

Conference Summary

Opportunities and Challenges of Sustainable Development in the Pearl River Delta Bay Area under the Belt and Road Initiative

The 8th Guangdong Hong Kong Macau Sustainable Development Conference will be hosted by the Hong Kong Institution of Engineers (HKIE), with Guangdong Provincial Association for Science and Technology and the Macau Institution of Engineers as joint organisers. The conference is jointly organised by the Environmental and Civil Divisions of HKIE. Since its inception in 2002, the Conference has become one of the most important cooperation platforms and a channel for sharing views and experiences among professionals, academics, policy makers and other stakeholders in Guangdong, Hong Kong and Macau.

The main theme of the Conference is "**Opportunities and Challenges of Sustainable Development in the Pearl River Delta Bay Area under the Belt and Road Initiative**", The Belt and Road Initiative is an important strategy for China's external and internal development. The Pearl River Delta Bay Area (PRD Bay Area) has become a major focus of future development and growth. The conference would cover five key development concepts: innovative development, coordinated development, open development, green development and shared development. The three objectives of development are economic vibrancy, environmental sustainability and social harmony. The conference would promote discussion on the future development trends and thinking in the PRD Bay Area under the Belt and Road Initiatives and the overall sustainable development master planning and challenges. It would also facilitate dialogue on the opportunities and challenges of sustainable development in various cities in PRD Bay Area. The conference also serves to promote cooperation and synergy on sustainable economy, transport, information and smart cities; environment and green development (air, water resources, green buildings); energy and climate change; and social development and the trends towards international standardisation and management."

As The Belt and Road Initiative is at the initial stage, the engineering community will work closely with the Hong Kong Government to take this forward. The Environment & Civil Divisions of the Hong Kong Institution of Engineers aim to raise the standards of major infrastructure under The Belt and Road Initiative, There are numerous infrastructure projects in progress, including railway, highway, and harbours, which would adopt the standards of the advanced countries. Hong Kong engineering industry can provide the consulting service and can be involved in the construction, operation management, meeting the needs of high-end service industry and promoting the green development and green lifestyle at the same time.

Guangdong Provincial Association for Science and Technology aims to accelerate the development of the PRD Bay Area under the Belt and Road Initiative, raise the efficiency of regional allocation of resources and build closer cooperation relationship among Guangdong province, Hong Kong and Macau as an important strategy. On the one hand, it would enhance the regional sustainable economic growth while building up development momentum reaching out to the nearby region and to strengthen the Belt and Road Initiative, with the PRD Bay Area as a focal point to create an open and comprehensive development pattern through "Land/Sea, Internal/External linkages" and "Openness to the East and West".

Macau aims to provide a platform for exchange and deepen the co-operation among China, the Portuguese Speaking Countries and Macau, In order to support the diversification of the economy and strengthen the development of the adequate industrial sectors in Macau. Mainland China also agrees to enhance the cooperation in convention and exhibition sector. Besides, Mainland China fully supports and coordinates with Macau to hold International conferences and events. AEM would like to collaborate with the professional community to build a Lusophone Platform for cooperation among engineers in support of the social and economic development of China, Macau SAR and Portuguese-speaking countries.

The Belt and Road Initiative involve over sixty countries and emerging economies and complements the development in Guangdong, Hong Kong and Macau. We expect that the exchange among professionals and academics from Guangdong, Hong Kong and Macau would help to promote the development of the industry, meet the needs of societal, economic, environmental and sustainable development and prepare for future sustainable development opportunities and challenges.

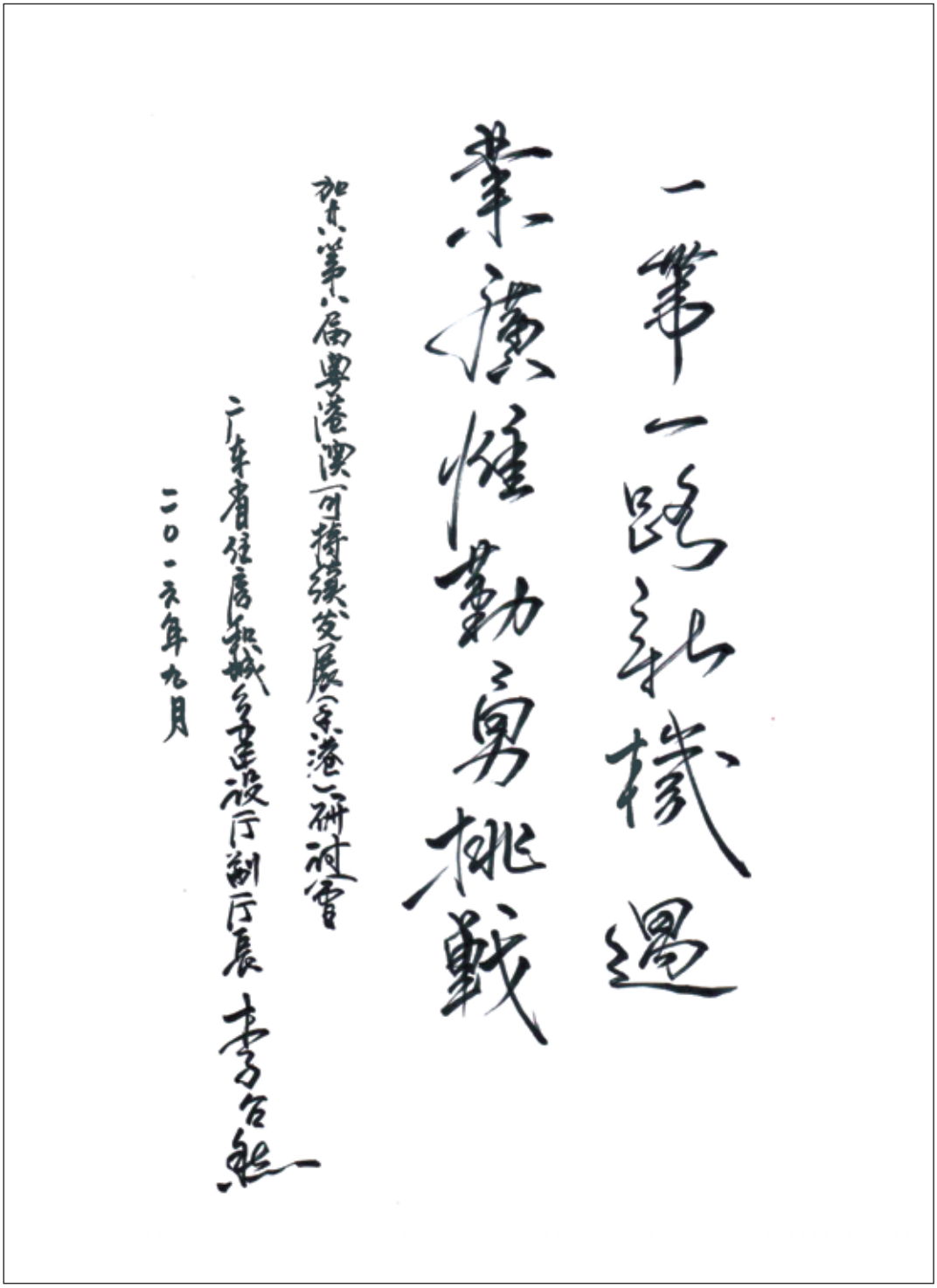
香港特別行政區環境局局長
黃錦星先生, G.B.S.,JP

第八屆粵港澳可持續發展研討會

氣候行動 邁向低碳

環境局局長黃錦星

廣東省住房和城鄉建設廳副廳長
李台然先生



第八屆粵港澳可持續發展研討會籌委會主席賀辭－區偉光工程師
Congratulatory Message from Ir Elvis AU, Chairman of The 8th Guangdong Hong Kong Macau Sustainable Development Conference

第八屆粵港澳可持續發展研討會籌委會主席賀詞
區偉光工程師

粵港澳可持續發展研討會至今已成功舉辦了七屆，全賴粵港澳工程界、科技界及社會各界的認同和大力支持。是次第八屆會議由香港工程師學會的環境分部及土木分部承辦，而合辦單位為廣東省科學技術協會及澳門工程師學會。此研討會的目的以創新發展、協調發展、開放發展、綠色發展及共享發展為大方向，七大範疇作為討論重點，加強粵港澳的交流與合作。

目前「一帶一路」及粵港澳大灣區倡議尚處於起步階段，許多細節仍需逐步落實。為配合國家推行「一帶一路」政策，粵港澳工程界及科技界需要加強合作，推動粵港澳大灣區先進技術及管理經驗的輸入及輸出。

香港工程界可以為「一帶一路」沿線地區及粵港澳大灣區提供優質顧問服務和參與建設營運管理，帶動高端服務業，同時推動綠色發展與綠色生活。香港工程師學會可以扮演重要的專業角色，憑著香港專業人士的國際經驗和視野，從粵港澳大灣區的整體長遠利益出發，按可持續發展的原則，提升「一帶一路」沿線國及粵港澳大灣區發展質素，將發展推向國際的水平，並提高環境管理能力。

正因為「一帶一路」需要各地及各界人士共同合作，我希望透過今次第八屆的研討會，業界專家們可以互相交流及分享對於「一帶一路」大灣區可持續發展機遇與挑戰的見解，並加強合作。

我藉此機會亦想衷心感謝三地代表、各位嘉賓、講者與參會者，以及支持和贊助機構的傾力支持，籌備委員會的付出。全賴你們的熱心參與，令研討會順利進行。希望閣下能享受整個研討會並有所得益。謝謝！

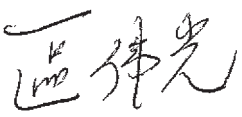
With the full support of the engineering, technology and various sectors, the Guangdong Hong Kong Macau Sustainable Development Conference (GDHKMSDC) has been successfully held seven times. The 8th GDHKMSDC is hosted by the Hong Kong Institution of Engineers (HKIE) through its Environmental Division and Civil Division, with the Guangdong Provincial Association for Science and Technology and the Macau Institution of Engineers as joint organizers. This conference embraces five key development directions (innovative development, coordinated development, open development, green development and shared development) and covers seven key themes, with a view to promoting exchange and cooperation.

The Belt and Road Initiative (BRI) and the Pearl River Delta Bay Area (PRDBA) development concept are at an initial stage. To support the BRI, there is a need for stronger cooperation among the engineering and technology sectors in Guangdong, Hong Kong and Macau, with a view to promoting the import and export of advanced technology and management knowhow in the PRDBA.

Hong Kong's engineering sector can provide quality professional services, participate in the construction and operation of development, take forward advanced services industry and promote green development and green living. With its international expertise and vision, HKIE can play a pivotal role. Hong Kong's professionals can help raise the quality of development towards international standards and enhance the environmental management capability, in line with the long term overall benefits of PRDBA and the principles of sustainable development.

In view of the need for stronger cooperation among various sectors, I hope that this conference can facilitate exchange and cooperation among professionals and academics about the opportunities and challenges of sustainable development under the BRI and in PRDBA.

I would like to thank all distinguished guests and the representatives and participants from Hong Kong, Guangdong and Macau as well as the sponsoring and supporting organization and our organizing committee members. It is only with your support that this conference can be held. I hope you enjoy and benefit from this conference. Thank you.



區偉光工程師
第八屆淘澳可持續發展研討會籌委會主席

第八屆粵港澳可持續發展研討會籌委會副主席賀辭－江垂燊工程師
Congratulatory Message from Ir KONG Shui Sun, Vice Chairman of The 8th Guangdong Hong Kong Macau Sustainable Development Conference

第八屆粵港澳可持續發展研討會籌委會副主席
江垂燊工程師

憑藉粵港澳工程界人士、科技界乃至社會各界的廣泛認同和鼎力支持，粵港澳可持續發展研討會經已成功舉辦了七屆。第八屆研討會主題為「一帶一路下大灣區可持續發展機遇與挑戰」，以配合國家推動的「一帶一路」大政策。

粵港澳大灣區的經濟實力，無疑為我們奠定了堅實的基礎，為「一帶一路」政策的推動，作出不同層面的貢獻。「一帶一路」的無限機遇，也代表著極為不一樣的市場動力，對各個有意參與的行業和專業，必須深入了解其存在的挑戰。至於工程界，我們的最大挑戰，是再優化既往的做法，精益求精，發展和培養新的增長潛力，加快工程界參與「一帶一路」的範疇，運用我們世界級的工程標準、人才和往績，積極參與「一帶一路」沿線國家發展，為未來創造更大的成功。

工程界可以為「一帶一路」沿線地區提供顧問服務和參與建設營運管理，帶動高端服務業的需求，同時推動綠色發展與綠色生活。是次研討會正好為一眾專家提供一個平台作分享，促進工程界專業知識與經驗交流，加強合作。

在此，我衷心感謝三地代表、各位嘉賓、講者、與會者、支持機構以及熱心贊助的機構，期望各位能享受研討會每個精彩環節並有所得益，讓是次研討會得空前的成果。

Through the support from professionals, academics and various stakeholders in the industries over the past years, Guangdong - Hong Kong - Macau Sustainable Development Conference has been successfully held for seven times. In this moment the Conference is themed"Opportunities and Challenges of Sustainable Development in the Pearl River Delta Bay Area under the Belt and Road Initiative", to coincide with the great China's "One Belt One Road" Initiative.

It is without doubt that the strong economic power of the PRD Bay Area region has positioned us well to contribute in many meaningful ways to the success of the Belt and Road Initiative. The initiative's immense opportunities come with very different market dynamics, which have presented huge challenges for all market segments and players. For the engineering community, our biggest challenge lies on our ability to advance ourselves, develop and nurture growth potential, accelerate our speed to participate in the new initiative, position as an engineering expertise centre where our best-in-class standards, talent and proven record could be leveraged or even exported to support the market growth in the Belt and Road countries.

The engineering professionals are committed to providing a high quality consultancy service and support to the management of construction and operations in "One Belt One Road" projects; in parallel promoting green measures and development. This Conference provides an excellent platform for the professionals and academics from various areas to share our expertise and experience on this theme, and strengthen collaboration.

I would like to express great gratitude to all the distinguished guests, participants, supporting organisations and sponsors of this Conference. I wish the Conference big success while all participants getting the best insight of the "One Belt One Road" Initiative.

主辦機構代表賀辭－香港工程師學會會長蔡健鴻工程師
Congratulatory Message from Ir Joseph K H CHOI, President for The Hong Kong Institution of Engineers

香港工程師學會會長
蔡健鴻工程師

THE HONG KONG INSTITUTION OF ENGINEERS
香港工程師學會
9/F Island Beverley, No 1 Great George St, Causeway Bay, Hong Kong
Tel +852 2895 4446 Fax +852 2577 7791
hkie-sec@hkie.org.hk www.hkie.org.hk

會長 蔡健鴻 工程師
President Ir Joseph K H CHOI
BSc(CVL) CEng FHKIE FHKIHT MICE R.P.E.(CVL)
president@hkie.org.hk

第八屆粵港澳可持續發展研討會

聚三地才彥共鑄宏圖

匯工程專業弘展新猷

香港工程師學會
會長 蔡健鴻工程師 敬賀

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合辦機構代表賀辭－廣東省科學技術協會常務副主席何真教授
Congratulatory Message from Professor HO, Executive Vice Chairman of Guangdong Provincial Association For Science and Technology

廣東省科學技術協會常務副主席
何真教授

一帶一路繪藍圖
共謀未來創新篇

賀第八届粤港澳可持续发展（香港）研讨会

廣東省科學技術協會常務副主席
何真
二〇一六年九月

合辦機構代表賀辭－澳門工程師學會理事長黃承發博士
Congratulatory Message from Dr WONG Seng Fat, Deputy Chairman of The Macau Institution of Engineers

澳門工程師學會理事長
黃承發博士

謹賀

「第八屆粵港澳可持續發展研討會」舉辦成功

賢聚集思

共建明天

澳門工程師學會　理事長　黃承發　博士

二零一六年九月二十三日

第八屆粵港澳可持續發展研討會組織架構名單
The Oranganizing Committee of The 8th Guangdong Hong Kong Macau Sustainable Development Conference

一、主辦單位

香港工程師學會
廣東省科學技術協會
澳門工程師學會

二、組織委員會

主席：蔡健鴻工程師	香港工程師學會會長
何真	廣東省科學技術協會常務副主席
譚立武	澳門工程師學會會長

三、執行委員會

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江垂樂工程師	香港工程師學會土木分部主席
馮日光	廣東省科學技術協會專職副主席
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黃承發	澳門工程師學會理事長
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鍾小平工程師	香港工程師學會土木分部副主席
陸偉霖工程師	香港工程師學會土木分部理事
張均榮工程師	香港工程師學會土木分部理事
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張幹	廣東省可持續發展協會理事長
周永章	廣東省低碳產業技術協會理事長
張偲	廣東海洋學會理事長
黃良民	廣東海洋湖沼學會理事長
莊旭東	廣東省氣象學會理事長
朱竑	廣東省地理學會理事長
蕭志泳	澳門工程師學會副理事長
陳桂舜	澳門工程師學會副理事長
黃傑勇	澳門工程師學會副理事長

第八屆粵港澳可持續發展研討會組織架構名單
The Oranganizing Committee of The 8th Guangdong Hong Kong Macau Sustainable Development Conference

四、學術委員會

香港：

勞敏慈教授工程師	香港工程師學會環境分部前任主席
葉達仁工程師	香港工程師學會環境分部前任主席
林志成工程師	香港工程師學會環境分部理事
周雯雯工程師	香港工程師學會環境分部理事
吳兆堂教授工程師	香港工程師學會土木分部理事
張志成教授工程師	香港工程師學會土木分部理事

廣東省：

黃嘉璜	廣東省科學技術協會合作交流部副部長
符正平	中山大學粵港澳發展研究院教授
梁偉雄	廣東省土木建築學會常務副秘書長
歐陽婷萍	廣東省可持續發展協會秘書長
劉連成	廣東省低碳產業技術協會秘書長
王剛	廣東省環境科學學會副秘書長
徐建平	廣東省氣象學會副秘書長
林洪瑛	廣東海洋湖沼學會秘書長、廣東海洋學會常務副秘書長
裘鋼	廣東省地理學會秘書長

澳門：

陳耀宗	澳門工程師學會常務理事
賴健榮	澳門工程師學會常務理事
周子健	澳門工程師學會常務理事
林智超	澳門工程師學會常務理事
高冠鵬	澳門工程師學會理事

五、財務處

香港：陸偉霖工程師	香港工程師學會土木分部理事
廣東：張美薇	廣東省土木建築學會副秘書長、辦公室主任
澳門：黎永光	澳門工程師學會財務主任

六、秘書處

廣東：楊曉新	廣東省科學技術協會合作交流部調研員
香港：林志成	香港工程師學會(土木及環境分部) 工程師
澳門：林遠裙	澳門工程師學會財務主任

時間	項目	
	研討會	
8:30-9:00	與會者登記	
9:00-9:05	**籌委會主席致歡迎辭** 香港工程師學會環境分部主席區偉光工程師	
9:05-9:10	**主禮嘉賓致辭** 香港特別行政區環境局局長黃錦星先生，G.B.S., JP	
9:10-9:15	**廣東省代表致辭** 廣東省住房和城鄉建設廳副廳長李台然先生	
9:15-9:20	**香港代表致辭** 香港工程師學會會長蔡健鴻工程師	
9:20-9:25	**澳門代表致辭** 澳門工程師學會理事長黃承發博士	
9:25-9:30	**大合照**	
主題演講	**演講方向：一帶一路下大灣區可持續發展機遇與挑戰**	
9:30-9:50	**主題演講1 － 粵港澳合作推動大珠三角綠色智慧城市發展** 香港綠色策略聯盟主席盧偉國博士工程師(香港)	
9:50-10:10	**主題演講2 －"十三五"時期粵港澳區域合作趨勢與策略研究** 中山大學粵港澳發展研究院副院長陳廣漢教授(廣東)	
10:10-10:30	**主題演講3 － 澳門城市可持續發展研究** 澳門科技大學環境研究院王志石教授(澳門)	
10:30-10:50	**主題演講4 － 省港澳之於"一帶一路"** 保華建業集團有限公司主席趙雅各工程師,OBE, JP及 中國環境保護集團有限公司總工程師吳曉工程師(香港)	
10:50-11:05	小休	
11:05-11:25	**主題演講5 － 工業新動向－工業可持續性** 香港工業總會主席鄭文聰教授工程師(香港)	
11:25-11:45	**主題演講6 － 廣州城市軌道交通的可持續發展** 廣州地鐵集團副總工史海鷗先生(廣東)	
11:45-12:05	**主題演講7 － 可持續發展與校園交通運輸之探討** 澳門大學科技學院溫日明講師(澳門)	
12:05-12:25	**主題演講8 － 從香港城市規劃策略的區域視角看粵港澳大灣區的可持續發展** 香港特別行政區規劃署署長凌嘉勤先生，JP(香港)	
12:25-12:30	**致送紀念品予主題講者及贊助商**	
12:30-1:30	午餐	
專題演講	**演講方向：智能城市**	**演講方向：可持續的基建發展**
1:30-1:45	**題目：城鄉生活圈規範與建設方法芻議** 中山大學教授／中國地理學會副秘書長／ 廣東地理學會副秘書長／中山大學地理學院城市與區域規劃系系主任／國家註冊城市規劃師／ 廣州市政府重大行政決策諮詢專家 劉雲剛教授 (廣東)	**題目：協調政策和實踐以增強粵港澳大灣區的城市及區域韌性和可持續發展** 香港大學土木工程系吳兆堂教授 及博士後研究員徐軍 (香港)

會議流程
Conference Programme

時間	項目	
1:45-2:00	**題目：智慧、綠色及韌性基礎設施規劃** 奧雅納工程顧問管理咨詢 | 政策與可持續發展主任 莊宏曦工程師 （香港）	**題目：“一帶一路”與香港經濟第三次轉型** 中山大學自貿區綜合研究院副院長／港澳珠江三角洲研究中心教授、博士生導師／粵港澳發展研究院海上絲綢之路與粵港澳國際合作研究中心主任／ 中國自由貿易試驗區協同創新中心學術委員會委員／ 廣東海上絲綢之路研究院學術委員會委員 毛豔華教授 （廣東）
2:00-2:15	**題目：對廣東省交通運輸業增加值和碳排放脱鉤指數的分解分析** 中國科學院廣州地球化學研究所可持續發展研究中心 趙亞蘭博士 （廣東）	**題目：發展智能城市以滿足珠三角地區的未來需求** 莫特麥克唐納部門董事 程明錦先生 （香港）
2:15-2:30	**題目：「一帶一路」在大珠江三角洲區域對澳門特別行政區的地緣政治優勢** 澳門聖若瑟大學 利天佑教授 （澳門）	**題目：「一帶一路」發展下香港國際機場面對的機遇和挑戰** 香港機場管理局企業發展執行總監 馮永業先生 （香港）
專題演講	**演講方向：環境Built Environment,綠色發展綠色建築**	**演講方向：可持續的能源及水資源供應與使用及氣候變化的挑戰與機遇**
2:30-2:45	**題目：香港可持續發展的獨特優勢及國際經驗** 香港綠色建築議會執行董事 陳永康工程師 （香港）	**題目：以“兩山論”為指導“探索編制自然資金源資產負債表** 深圳市環境科學研究院生態所所長／ 深圳市自然資源資產核算與評估中心主任 葉有華博士高級工程師 （廣東）
2:45-3:00	**題目：綠化節能一體化現澆輕質混凝土牆體施工工藝研究** 廣東省建築科學研究院集團股份有限公司建材事業部主任 李建新博士 （廣東）	**題目: 香港全面水資源管理策略** 水務諮詢委員會主席 漢臻顧問有限公司董事總經理 陳漢輝博士工程師 （香港）
3:00-3:15	**題目：可持續發展變電站：環保及應對氣候變化的電力供應** 中華電力有限公司署理工程項目總監 陳國華先生 （香港）	**題目：氣象變化背景下廣東近10年冷冬頻發成因分析** 廣東省氣象局氣候中心 郝全成高級工程師 （廣東）
3:15-3:30	**題目：建築余泥渣土受納場建設管理技術調研** 廣東省建築科學研究院集團股份有限公司總工室主任助理、教授級高級工程師、一級註冊結構工程師 許燕祿先生 （廣東）	
3:30-3:45	小休	
閉幕主題演講	**演講方向：可持續的環境及綠色發展(空氣，水，綠色建築)**	
3:45-4:05	**閉幕主題：粵港澳珠江口紅樹林濕地的可持續發展** 中國科學院南海海洋研究所博士生導師 徐向榮研究員 （廣東）	
4:05-4:25	**閉幕主題：由可持續發展邁向生態文明** 香港特別行政區環境局副局長陸恭蕙女士, JP(香港)	
4:25-4:30	**致送紀念品主題講者**	
4:30-4:35	**下屆主辦單位交接儀式**	
4:35-4:50	**閉幕致辭** 香港工程師學會土木分部 江垂樂工程師	

Time	Program	
	Conference	
8:30-9:00	Registration	
9:00-9:05	**Welcoming speech** Ir Elvis AU Wai Kwong Chairman of Environmental Division, The Hong Kong Institution of Engineers	
9:05-9:10	**Speech from Guest of Honour** Mr WONG Kam Sing, G.B.S., JP Secretary for the Environment, Environment Bureau, HKSARG	
9:10-9:15	**Speech from Guangdong representative** Mr LI Tai Ran Deputy Director for Housing and Urban-Rural Development of Guangdong Province	
9:15-9:20	**Speech from Hong Kong representative** Ir Joseph K H CHOI President for The Hong Kong Institution of Engineers	
9:20-9:25	**Speech from Macau representative** Dr WONG Seng Fat Deputy Chairman for The Macau Institution of Engineers	
9:25-9:30	**Group Photo**	
Keynote Speaker Presentation	**Topic Direction: Opportunities and Challenges of Sustainable Development in the Pearl River Delta Bay Area under the Belt and Road Initiative**	
9:30-9:50	**Presentation 1: Co-operation between cities motivates Green development** Ir Dr LO Wai Kwok, S.B.S., MH, JP Chairman for Hong Kong Green Strategy Alliance (Hong Kong)	
9:50-10:10	**Presentation 2: The co-operation trend and strategies between Guangdong, Hong Kong and Macao in the period of the "Thirteenth Five-Year Plan"** Prof Chen Guang Han Associate Dean for Institute of Guangdong, Hong Kong and Macao Development studies , Sun Yat-Sen University (Guangdong)	
10:10-10:30	**Presentation 3: Sustainable development of Macau** Prof WANG Zhi Shi Director for Macau Environment Research Institute of Macau University of Science and Technology (Macau)	
10:30-10:50	**Presentation 4: The 3 Pearl River Delta Cities and "One Belt One Road"** Ir James CHIU, Hon FHKIE FHKEng, OBE, JP Chairman, Paul Y. Engineering Group Limited and Ms Wu Xiao Chief Engineer, China National Environmental Protection Group (Hong Kong)	
10:50-11:05	Short Break	
11:05-11:25	**Presentation 5: The movement and the sustainability in industrial sector** Prof Ir Daniel M Cheng Chairman for Federation of Hong Kong Industries	
11:25-11:45	**Presentation 6: The sustainable development of Guangzhou urban rail transit** Mr Shi Hai Ou Deputy Chief Engineer of Guangzhou Metro Group co., LTD (Guangdong)	
11:45-12:05	**Presentation 7: A Study of Sustainable Campus Transportation in Macau** Mr Wan Iat Meng Faculty of Science and Technology, University of Macau (Macau)	
12:05-12:25	**Presentation 8: Sustainable Development of the 'Big Bay Area' from the Hong Kong Strategic Planning Perspective** Mr K. K. Ling, JP Director for The Government of the Hong Kong Special Administrative Region of Planning Department (Hong Kong)	
12:25-12:30	**Souvenir for keynote speaker and sponsors**	
12:30-1:30	Lunch Break	
Speaker Presentation	**Speech Direction: Intelligent City**	**Speech Direction: Sustainable Infrastructure Development**
1:30-1:45	**Topic: Urban and rural life circle series the standard and construction method** Prof Liu Yun Gang Sun Yat-Sen University, Deputy Secretary of The Geographical Society of China (Guangdong)	**Topic: Policy Coordination and Application to Strengthen Guangdong Hong Kong Macau cities and District Tenacity as well as Sustainable Development** Prof Thomas Ng, Professor and Dr Xu Jun, Post-doctoral Fellow Department of Civil Engineering, The University of Hong Kong (Hong Kong)

會議流程
Conference Programme

Time	Program	
1:45-2:00	**Topic: Infrastructure and facilities planning through Wisdom, Green and Toughness** Ir Bruce W H Chong East Asia Sustainable Infrastructure Design Leader Management Consulting | Policy & Sustainability Arup (Hong Kong)	**Topic: One Belt and Road' and the Third Economic Transition of Hong Kong** Prof Mao Yan Hua Sun Yat-Sen University, Associate Dean for Institute of Free trade zone comprehensive research , Sun Yat-Sen University (Guangdong)
2:00-2:15	**Topic: Opportunities and Challenges of Sustainable Development in the PRDBA under OBOR: Macau Functional Subsidiarity** Dr Zhao Ya Lan Sustainable Development Research Center, Guangzhou Institute of Geochemistry, CAS (Guangdong)	**Topic: Smart cities to meet the future needs of the PRD Region** Mr Eric Ching Director Mott MacDonald (Hong Kong)
2:15-2:30	**Topic: OBOR is Reshaping Geopolitics: The Macau Functional Subsidiarity** Dr Francisco J. B. S. Leandro Assistant Professor University of Saint Joseph	**Topic: The Opportunities and Challenges facing HKIA in light of the Belt and Road Development** Mr Wilson Fung Wing Yip Executive Director, Corporate Development for Hong Kong International Airport (Hong Kong)
Speak Presentation	**Speech Direction: Built Environment, Green Development Green Building**	**Speech Direction: Sustainable energy, Water supply, and Use of Challenges and Opportunities from Climate Change**
2:30-2:45	**Topic: Sustainable Development – Hong Kong's Strength and International Experience** Ir Cary Chan Executive Director, Hong Kong Green Building Council (Hong Kong)	**Topic: A Discuss on natural sources of capital balance guided by the theory of "two mountain"** Ir Dr Ye You Hua Director of Shenzhen Ecological Environmental Science Research Institute (Guangdong)
2:45-3:00	**Topic: Integration of green and energy-saving cast-in-place lightweight concrete wall construction technology research** Dr Li Jian Xin Guangdong Provincial Institute of Building Research Group co., LTD (Guangdong)	**Topic: Total Water Management in Hong Kong** Ir Dr Chan Hon Fai Chairman, Advisory Committee on Water Supplies / Managing Director, Cinotech Consultants Limited (Hong Kong)
3:00-3:15	**Topic: Sustainable Substation: Green and Climate Resiliency for Sustainable and Reliable Supply to Hong Kong** Mr Chan Kwok Wah, Keith, Acting Director, Engineering Projects and Mr Ho Siu Kwong, Director, Asset Management CLP Power Hong Kong Limited (Hong Kong)	**Topic: Cold winter frequency analysis in recent 10 years in Guangdong under the background of climate change** Ir Hao Quan Cheng Guangdong Meteorological Service
3:15-3:30	**Topic: Research in technology of managing the places on collecting and dealing with urban construction waste residue** Ir Xu Yan Lu Guangdong Provincial Institute of Building Research Group co., LTD (Guangdong)	
3:30-3:45	Short Break	
Closing Session	**Speech direction: Sustainable Environment and Green Development (Air, Water, Green Building)**	
3:45-4:05	**Closing Theme: The sustainable development of guangdong Pearl River Estuary mangrove swamp** Dr Xu Xiang Rong South China Sea Institute of Oceanology, CAS (Guangdong)	
4:05-4:25	**Closing Theme: From Sustainable Development To Ecological Civilization** Ms Christine Loh, JP Under Secretary for the Environment, HKSARG (Hong Kong)	
4:25-4:30	**Souvenir Presentation to Speakers**	
4:30-4:40	**Next Organiser Handover Ceremony**	
4:40-4:50	**Closing Speech** Ir S S Kong Chairman of Civil Division, The Hong Kong Institution of Engineers	

** The English version program rundown is just for reference, it will not be liable for any errors or misinterpretation. The Chinese version shall prevail.*
** Cantonese or Putonghua, with simultaneous translation into English*

THE HONG KONG INSTITUTION OF ENGINEERS
香 港 工 程 師 學 會

歷史
History

一九八二年是香港工程師學會重要的一年。香港政府確認學會的法定會籍為公務員(專業工程師職級)的入職資格，其後各工程機構亦紛紛相隨，確認學會的法定會籍為入職的主要條件。

工程界向來積極參與公共事務，於立法會功能界別議席中亦特設工程界議員一席，而負責投票選出特區行政長官之一千二百人選舉委員會中，工程界別佔其中三十席。以上代表均由學會的法定會員投票選出。此外，學會資訊科技分部之法定會員及初級會員均可有投票權，負責選出立法會資訊科技界別及其於選舉委員會的代表。由此可見工程界的專業意見備受政府及社會人士重視。

學會與世界各地工程團體保持緊密聯繫，與內地、澳洲、加拿大、愛爾蘭、新西蘭及英國多個工程資格審核團體簽署了專業資格互認協議。此外，學會亦與內地、歐洲、北美洲及東南亞不同專業團體簽署合作協議。

一九九五年六月，學會成為「華盛頓協議」的成員，經學會所審核之工程學位均獲其他成員包括澳洲、加拿大、中華台北、愛爾蘭、日本、韓國、馬來西亞、新西蘭、新加坡、南非、土耳其、英國及美國的認可。此外，香港亦於一九九九年成為「亞太工程師計劃」的創辦成員，香港的註冊專業工程師均合乎資格註冊成為香港亞太工程師。

二零零一年六月，學會成為「悉尼協議」的創始簽約成員。根據此協議，所有經學會審核之高級文憑或副學士課程均獲得多個簽署成員包括澳洲、加拿大、愛爾蘭、新西蘭、南非、英國及美國的承認。在專業工程師及工程技術員的多邊資格互認方面，學會亦成為「工程師流動論壇」及「工程技術員流動論壇」創辦成員之一。上述的兩項協定前者是旨在提供國際工程師資歷互認藍圖予各成員的相關團體，後者則主要為推動工程技術員資格的多邊互認工作做準備。

學會已於二零零二年四月在香港展開了「工程師流動論壇 — 國際工程師」及「亞太工程師」的註冊工作，而「工程技術員流動論壇 — 國際工程技術員」的註冊工作亦已於二零零八年二月展開。

二零零九年六月，學會成為「首爾協議」的成員，經學會所審核之電腦科學學位均獲其他成員包括澳洲、加拿大、中華台北、日本、韓國、英國及美國的認可。

學會是世界工程組織聯盟(WFEO)的附屬會員及亞洲及太平洋工程師協會聯盟(FEIAP)的會員。

今屆主辦機構 －香港工程師學會簡介
Organizer - History of The Hong Kong Institution of Engineers

The Engineering Society of Hong Kong was founded in 1947 with the aim of bringing together engineers of different Disciplines for their common good. The Society flourished and as a result the Hong Kong Institution of Engineers (the HKIE), was incorporated under the Hong Kong Institution of Engineers Ordinance, Chapter 1105 of the Laws of Hong Kong in 1975. Adapting to the needs of engineers in Hong Kong, the Institution continues to develop and expand.

The Institution sets standards for the training and admission of engineers. It has strict rules governing the conduct of its members and, as a learned society. It enables its members to keep abreast of the latest developments in engineering. Many of the learned society activities take place at the Institution's Headquarters in Causeway Bay. It provides a venue for seminars, talks and meetings as well as the office of the Secretariat.

An important development in 1982 was the Hong Kong Government's decision to recognize Corporate Members of the HKIE for civil service. Most engineering companies in Hong Kong recognize Corporate Membership of the HKIE as the key qualification for employment of professional engineers.

On the participation of the engineering profession in public affairs, we have one seat representing the Engineering Functional Constituency in the Legislative Council, and among the 1,200-member Election Committee (EC) for the election of the Chief Executive of the HKSAR, there are 30 EC members from the Engineering Subsector. These representatives are elected by the Corporate Members of the Institution. In addition, Corporate Members and Graduate Members of Information Technology Division of the Institution are eligible to vote for the representatives in the Information Technology Functional Constituency in the Legislative Council and its Election Committee Subsector. Views of the engineering profession are well respected both by the HKSAR Government and the community through these establishments.

The HKIE has established close relationship with engineering institutions throughout the world and it has signed agreements for reciprocal recognition of professional qualifications with engineering authorities in Australia, Canada, Ireland, the Mainland, New Zealand and the United Kingdom. It has also signed agreements of co-operation with other organizations in Europe, the Mainland, North America and Southeast Asia.

In June 1995, the HKIE joined the Washington Accord as one of the signatories. The engineering degrees accredited by the HKIE are recognized by other signatories including Australia, Canada, Chinese Taipei, Ireland, Japan, Korea, Malaysia, New Zealand, Singapore, South Africa, Turkey, the United Kingdom and the United States.

In 1999, Hong Kong became a founding member of the APEC Engineer Framework. Registered Professional Engineers (R.P.E.) in Hong Kong are eligible to register as Hong Kong APEC Engineers.

In June 2001, the Institution became a founding signatory to the Sydney Accord. Under this Accord, higher diplomas and associate degrees accredited by the HKIE are recognized by other signatories including Australia, Canada, Ireland, New Zealand, South Africa, the United Kingdom and the United States. On multilateral recognition of engineers' and technologists' qualifications, the Institution is a founding member of the Engineers Mobility Forum and the Engineering Technologists Mobility Forum. The former is to provide a framework for the recognition of experienced professional engineers by responsible bodies in each of the signatory economy, while the latter is a framework that facilitates multilateral recognition of technologists' qualifications.

Both the APEC Engineer Register in Hong Kong and the Engineers Mobility Forum International Register of Professional Engineers in Hong Kong were launched in April 2002. The Engineering Technologists Mobility Forum International Register of Engineering Technologists in Hong Kong was also launched in February 2008.

In June 2009, the Institution was admitted as a full signatory to the Seoul Accord. The computer science degrees accredited by the HKIE are recognized by other signatories including Australia, Canada, Chinese Taipei, Japan, Korea, the United Kingdom and the United States.

The HKIE is an affiliate member of World Federation of Engineering Organizations (WFEO) and a member of Federation of Engineering Institutions of Asia and the Pacific (FEIAP).

For further information in relation to Washington Accord, Sydney Accord, Engineers Mobility Forum, APEC Engineer, Engineering Technologists Mobility Forum and Seoul Accord, please refer to International Recognition and Events.

廣東省科學技術協會
Guangdong Provincial Association For Science and Technology

廣東省科學技術協會簡介
The Introduction of Guangdong Provincial Association for Science and Technology

廣東省科學技術協會是廣東省科學技術工作者的群眾組織，是廣東省政府聯繫科學技術工作者的橋梁和紐帶，是廣東省推動科學技術事業發展的重要力量。現有省級學會、協會、研究會160個，地級以上市科協21個，縣級科協121個，直屬事業單位5個。

主要任務

（一）開展學術交流，活躍學術思想，促進學科發展、知識創新。

（二）開展對外民間科學技術交流活動，發展同海外科學技術團體和科技工作者的友好交往。

（三）開展科學論證、諮詢服務，提出政策建議，促進科學技術成果的轉化；接受委托承擔項目評估、成果鑒定、技術評級等任務。

（四）弘揚科學精神，普及科學技術知識，傳播科學思想和科學方法，推廣先進技術。

（五）負責對所主管的有關學會、協會、研究會進行監督管理；對全省各地科協工作進行業務指導。

Guangdong Provincial Association for Science and Technology is a mass organization of the scientific and technical workers of Guangdong Province, is the bridge and link the Guangdong provincial government contacting with the scientific and technical workers, is an important force in the development of science and technology drive in Guangdong Province. Its prevailing institutions include 160 provincial societies; 21 municipal associations; 121 county-level associations and 5 direct companies under Guangdong Provincial Association for Science and Technology.

Primary tasks

(A) To promote academic communication, academic ideology, science development and knowledge innovation.

(B) To develop overseas folk science and technology activities, with friendly exchanges between the science and technology organizations and the science and technical workers from Guangdong and those overseas organizations.

(C) To develop scientific demonstration and consulting services, make policy recommendations, promote the transformation of scientific and technological achievement; to undertake tasks for authorization of project evaluations, achievement appraisal and technological evaluations.

(D) To advocate scientific spirit, popularize scientific and technical knowledge, propagate scientific ideas and methods and promote advanced technology.

(E) To supervise the provincial societies; to guide the operations of the associations for science and technology across Guangdong Province.

合辦機構－澳門工程師學會簡介
Co-organizer - History of The Macau Institution of Engineers

澳門工程師學會
Associação dos Engenheiros de Macau
The Macau Institution of Engineers

澳門工程師學會
The Macau Institution of Engineers

澳門工程師學會為一非牟利專業學會，於1987年向政府立案註冊，並於1988年正式成立。學會自成立至今，均一直朝著一貫的宗旨，不斷發展會務，除加強本澳工程師之間的團結及聯繫外，並與其他國家及地區之同類型組織保持聯繫及合作，在推動本澳工程界的發展上不遺餘力，同時學會亦與社會上工程及各界建立起不少的合作關係，努力提高工程師在社會上之專業地位，並同心合力地為澳門工程師專業的持續發展，努力地作出貢獻。

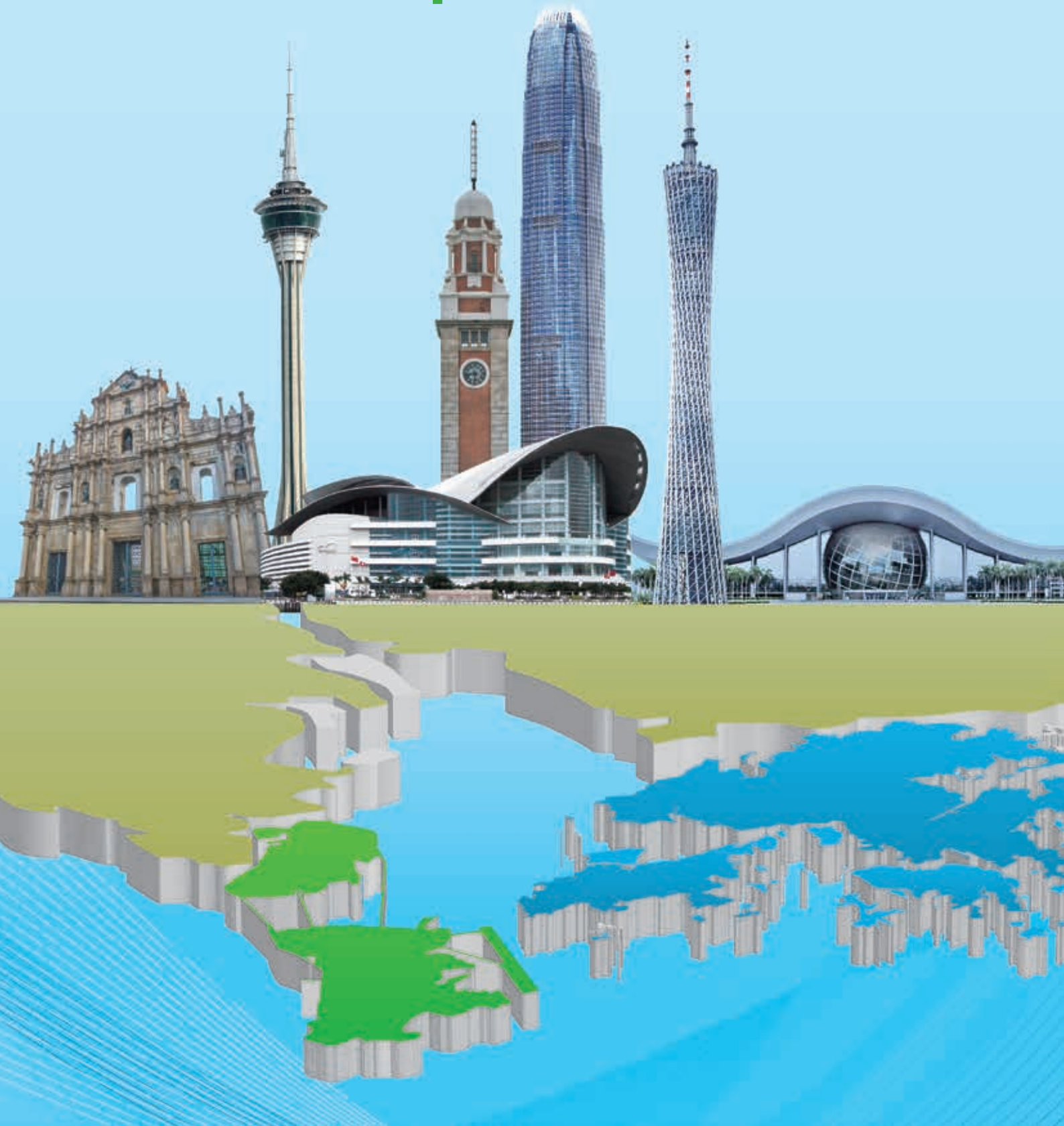
學會自88年成立以來，均不斷向外擴充並對外招收會員，目前會員人數眾多，他們分別來自於特區政府不同部門的工程師、大學教授、專營企業的工程師、如電力公司、電訊公司、自來水公司、水泥廠、污水處理廠、註冊執業工程師、及各大工程機構任職的工程師；在專業方面大致可分屬三大工程領域，分別為土木工程、電機工程及機械工程，此外還有資訊軟件工程、環境工程、化學工程、測量工程等。本會的架構設有會員大會、理事會及監事會。會員大會設立會長一人、副會長一人、大會秘書一人；理事會設立理事長一人、副理事長三人、常務理事五人，理事廿人；監事會設立監事長一人，副監事長一人、監事五人。會內幹事成員均為每兩年進行一次換屆選舉，現屆改選已於2012年底進行，並透過召開會員大會選出第十二屆理監事等幹事成員。本會除基本架構外，為了更有效地分工及推廣會務，本會特設有關注社會事務部、文康部、工程技術應用及、工程暨科普部及青年事務部等。各部分別設有部長一人、幹事若干，以更專精之方式組織各類活動。

The Macau Institution of Engineers was registered in 1987, officially found in 1987 is a non-profit professional association. Since then, the Association's purpose is strength the unity and connection with engineers in Macau, keep connected and cooperate with different organizations in other countries and regionals. Meanwhile, the Institution is promoting the local engineers and built the cooperation relationship with engineers and other industries improve the engineer's society status, contribute for the sustainable development of Macau engineers.

Since the Institution was found in 1988, we were continuing recruits the members, they were came from the engineers from different sections of the government, the college professors, engineers of Franchise business such as electric company, telecom company, water company, sewage treatment plant, registered engineers and engineers who are working for other engineering associations; there are three divisions in professionals, Civil Engineering, Electrical engineering and mechanical engineering, besides Information Software Engineering, Environmental Engineering, chemical engineering, Surveying Engineering etc. The institution has Members of the General Assembly, council and Supervisory Board. Under the members of the General assembly, there are one president, one vice-president, one secretary. Under the Council there are one director, three vice presidents and five executive directors. Under supervisory board, there are one chief supervisor, one Deputy Chief Supervisor and five supervisors. Within stewards members are biennial election, the current term of the election was carried out by the end of 2012, Officers and elected directors and supervisors and other members of the twelfth through the convening of the General Assembly. In order to more effectively promote the conference and division of labor, besides the basic structure, there are Ministry of Social Affairs, Ministry of Culture and Sport, Engineering Technology, Engineering and science section and Training center. Respectively, with one minister and several officers to organize the activities efficiently.

研討會講者資料 –
簡歷及論文摘要

Speakers' Material –
Bios and Paper Abstracts



主題報告－ 一帶一路下大灣區可持續發展機遇與挑戰
Keynote Presentation – Opportunities and Challenges of Sustainable Development in the Pearl River Delta Bay Area under the Belt and Road Initiative

盧偉國博士，工程師，SBS，MH，JP
香港綠色策略聯盟主席

簡歷

盧偉國博士、工程師、SBS、MH、JP，香港特別行政區立法會議員，代表工程界別。歷年來參與多個政府咨詢委員會、工商科技組織、專業機構工作。為香港工程師學會2007至08年度會長，並歷任沙田區議會議員多年。現任香港品質保證局主席、香港科技園公司董事、香港房屋委員會委員、醫院管理局成員、西九文化區管理局董事局成員等公職。並為香港經濟民生聯盟副主席、香港綠色策略聯盟主席、香港專業及資深行政人員協會上任會長。

盧君獲得英國華威大學工學博士學位，現為香港科技大學榮譽院士、英國華威大學工業院士、香港職業訓練局榮譽院士、香港公開大學榮譽教授、及香港城市大學兼任教授。

盧偉國博士在1992年獲頒「香港青年工業家獎」及「十大傑出青年」，於2001年獲香港特區行政長官頒發榮譽勛章(MH)，並於2004年7月獲委任為太平紳士(JP)，2009年榮獲銅紫荊星章(BBS)，2015年榮獲銀紫荊星章(SBS)。他在2015年香港工程師學會四十周年慶典榮登「香港工程界翹楚」榜。

摘要

《粵港澳合作推動大珠三角綠色智慧城市發展》

面對氣候變化，推動環保節能是現代城市當務之急。而隨著科技進步，未來城市發展也必然是以人工智慧為基礎，以人為本的可持續發展。粵港澳在綠色建築、智慧建築、減排節能等方面各自取得的經驗與成果，也面對氣候變化、大數據與資訊化快速發展下的共同問題。粵港澳可通過學術和科研的交流合作，和實質的循環經濟互動，進一步應用綠色化與智慧化的科技成果，全力推進大珠三角綠色智慧城市群建設。

主題報告－ 一帶一路下大灣區可持續發展機遇與挑戰
Keynote Presentation – Opportunities and Challenges of Sustainable Development in the Pearl River Delta Bay Area under the Belt and Road Initiative

陳廣漢，經濟學博士
中山大學粵港澳發展研究院副院長，首席專家
中山大學港澳珠三角研究中心主任，教授

簡歷

陳廣漢，經濟學博士。中山大學粵港澳發展研究院副院長，首席專家。教育部人文社會科學重點研究基地、中山大學港澳珠三角研究中心主任，教授。其他學術性兼職：全國港澳研究會副會長，中華發展經濟學研究會副會長，國務院發展研究中心港澳研究所高級研究員等。

長期從事西方經濟學理論、發展經濟學、區域經濟學、港澳珠三角經濟的教學和研究工作。主要著作有：《西方經濟發展思想史》(譚崇台主編)、《劉易斯的經濟思想研究》、《增長與分配—發展中國家面臨的選擇》、《港澳珠三角區域經濟整合與制度創新》、《香港回歸後的經濟轉型與發展研究》、《產業創新能力的培育與發展研究—珠江三角洲的發展路徑和趨勢》、《珠三角區域發展報告》等。其中《西方經濟發展思想史》1995年獲國家教委高校優秀科研成果一等獎。《劉易斯的經濟思想研究》和《港澳珠三角區域經濟整合與制度創新》先後兩次獲廣東省哲學社會科學著作類優秀成果二等獎，《澳門經濟增長的總需求分析(1982 – 1997)》獲首屆澳門人文社會科學優秀成果獎一等獎。

摘要

“十三五”時期是國家實現經濟發展方式轉變和構建開放型經濟新體制的關鍵時期，給粵港澳區域合作提供了新的要求和機遇。本文分析了“十三五”時期粵港澳區域合作的趨勢和目標，提出了以構建開放型經濟新體制和“一帶一路”建設為契機，以推進服務貿易自由化為重點，以創新科技產業為動力，以實體經濟轉型升級為依托，依托橫琴、前海和南沙三個粵港澳合作示范區，加快珠三角世界級城市群建設，打造粵港澳大灣區，採取“重點突破，點面結合，以點帶面，整體推進”策略，深化粵港澳區域合作的政策建議。

以構建開放型經濟新體制和“一帶一路”建設為契機，以推進服務貿易自由化為重點，以創新科技產業為動力，採取“重點突破，點面結合，以點帶面，整體推進”策略，依托橫琴、前海和南沙三個粵港澳合作示范區，創新合作體制和機制，提供可以全面復制和推廣的經驗，然後在全省推廣。加快行政審批制度改革，推廣商事登記制度改革，打造優質營商環境，形成與港澳相匹配的營商模式與規則；在企業設立經營許可、人才引進、產權等方面實行一站式服務，為港澳提供適宜創業發展的軟環境。爭取率先在粵港澳示范區內實現三地法律制度和相關規則的對接，充分借鑒港澳法律制度中與營商環境直接相關的商事、民事、契約法律，探索推進與港澳在法律制度、商事仲裁等方面的合作，加快推進與港澳商事調解機制的對接，待時機成熟爭取向全省進行推廣。逐步構建粵港澳現代服務業分工體系，深化科技產業和製造業合作，加快珠三角世界級城市群建設，構建粵港澳大灣區，推進“一帶一路”建設。加強社會和生態環境領域合作，使合作成果惠及三地民生，構建粵港澳民眾的共同家園。

主題報告－ 一帶一路下大灣區可持續發展機遇與挑戰
Keynote Presentation – Opportunities and Challenges of Sustainable Development in the Pearl River Delta Bay Area under the Belt and Road Initiative

王志石教授
澳門科技大學環境研究院教授

簡歷

王志石教授，澳門科技大學教授、澳門環境研究院院長。美國約翰•霍布金斯大學地理與環境工程系博士、哈爾濱工業大學建工學院市政工程學碩士、清華大學土木建築工程系給排水專業本科畢業。

自1994年以來一直從事著關於“澳門環境和城市發展”的研究計劃，其為澳門大學重點發展的科研項目之一。該研究計劃中的部分項目由中國國家自然科學基金委員會，澳門大學和澳門基金會聯合資助，同時也獲得過澳門科技發展基金的資助。並參與了國家863科技開發重點創新項目研究。

1992年組建了澳門大學環境工程專業的本科生和研究生的專業課程。引入新研究成果於課程之中，培養學生科研能力和職業技能。組建了澳門大學“環境工程實驗室”。發表了160多篇論文，大部分是在歐洲，北美，中國及香港，澳門等地的專業技術雜志和國際會議上發表，主要涉及：澳門環境與城市發展研究成果，澳門環境污染評價，環境經濟(能值分析，環境資源定價)，可持續發展及其在澳門的應用，水處理技術原理及其應用，遙感技術應用等。

摘要

澳門城市可持續發展研究

澳門科持續發展面臨著三個挑戰，即城市環境污染的壓力始終存在，如何評價這些不同環境介質中的污染，找到控制污染的途徑是實現可持續發展的第一項挑戰；其次，如何實現城市廢棄物的迴圈再利用是一項新的挑戰，首先需要在城市管理理念上創新；第三項挑戰是是實現可持續發展的各項政策的理論基礎研究，這是自然科學與社會科學的跨學科研究挑戰。

對於第一項挑戰，我們系統評價了澳門市區空氣污染，包括現場調研，儀器分析和電腦類比。通過澳門城區空氣中的顆粒物化學成分的分析，特別是正烷烴碳數GC圖譜分析確定了澳門空氣中顆粒物污染主要來自於化石燃料燃燒，具體的說就是機動車尾氣污染。而通過電子顯維分析(electronic microscopic analysis)，發現澳門空氣中顆粒物的組成和形貌也可以得出相同的結論，即市區機動車尾氣污染。然後通過生物電泳DNA氧化損傷分析，得出這種顆粒物(PM10)存在著對人體(遊客)的肺部組織DNA損傷風險。

針對澳門周圍水域的POP分析和調研，發現持續有機污染物POPs也是與水中的顆粒物向關聯，即發現多環芳烴和聚合有機鹵化物富集在河口低質顆粒物(sediment)之中，造成了對水生生態環境以及人體健康的潛在風險。總之，對於全球關注的持續有機污染，即POPs污染，我們針對澳門的具體情況作了一些初步工作，願意跟大家分享，交流。

而關於城市可持續發展戰略的相關的基礎理論研究，我們主要是作了如下研究工作1)利用計量經濟學方法研究了非市場貨品(如黑面琵鷺)和服務(如城市垃圾回收服務)的資產定價；2)研究了澳門城市生態足跡的供給和需求的平衡度量；以及3)澳門城市社會經濟運轉的能值分析。

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趙雅各工程師,OBE, JP
保華建業集團有限公司主席

簡歷

趙雅各工程師在業內備受尊崇。

他現為保華建業集團有限公司和英國通用工程(香港)有限公司主席，並一直積極參與內地／香港高速鐵路興建，港島線及機場快線等項目，其中部分是透過與跨國公司組成的合資企業參與。

趙工程師多年來積極投入業界和商業組織，曾任香港工程師學會會長、香港機電工程商協會主席、香港機電工程商聯會永遠會長及香港英國商會主席。他現時為建築環保評估協會有限公司董事局成員，以及香港工程科學院資深會員，並擔任司庫逾15年。

趙工程師於1993年被委任為太平紳士，其後於1994年獲授予大英帝國官佐勳章。

吳曉工程師
中國環境保護集團有限公司總工程師

簡歷

吳曉工程師從1993年至今一直從事電力建設及運行管理工作，在熱能工程、生活垃圾焚燒處理工藝技術、項目建設管理及生產運行管理方面都具備極高的技術水平及豐富的管理經驗。2011年主持參與的<成都洛帶城市生活垃圾焚燒廠項目>獲得中國有色金屬建設協會部級優秀工程設計一等獎.2012年5月被國家住建部中國成都環境衛生協會聘為中國城市環境協會專家。2011.12參加國家能源培訓中心培訓，取得節能評估師、諮詢師資格。曾參與編寫《垃圾焚燒發電廠－安裝與運行技術》，完成《生物質與城市生活垃圾混燒對焚燒廠運行影響的研究》、《焚燒爐內城市生活垃圾乾燥特性研究》等論文。

主題報告－ 一帶一路下大灣區可持續發展機遇與挑戰
Keynote Presentation – Opportunities and Challenges of Sustainable Development in the Pearl River Delta Bay Area under the Belt and Road Initiative

摘要

「一帶一路」是指重新振興、共同打造昔日橫貫歐亞大陸貿易路綫的跨國經濟合作概念。廣東、香港及澳門(即省港澳)，現稱珠江三角州，向來在這貿易路綫上扮演著相當重要的角色。無法參與「一帶一路」的西方國家會訕笑"OBOR"為"Our Bulldozer, Our Rule"－ 我們的推土機，我們的規則。

亞洲基礎設施投資銀行(簡稱亞投行)現正協助促進及推動「一帶一路」，相對于美國在二次世界大戰後倡議的馬歇爾計劃，亞投行的創立可算是中國多個世紀以來最明智之舉。

省港澳于多個世紀以來一直演變，在各自發展之餘，透過共同的粵方言、粵劇文化、嶺南畫等共通的基因相互聯繫。他們昔日為絲綢之路貿易提供物流及扮演著橋頭堡角色，今日的省港澳在國際語言、國際知識，乃至于銀行及金融的體制上已擁有足够的實力，其建築師、工程師、測量師以及管理人才更可以隨時候命，輸出海外。

事實上，現代社會十分倚賴可持續發展的基礎設施。因為良好的空氣質素、充足的電力及水務供應、妥善的廢物處理，可靠的交通運輸系統、道路及隧道、通訊系統等都是為人民締造理想居住環境，不可或缺的項目。而我們省港澳的建設專才正善于建構以上智能型城市中的基本系統。

不論亞投行及東道國有否參與投資，在「一帶一路」政策下，省港澳可通過建造、「建造、營運及移交」(BOT)，或「公共私營合作制」(PPP)加强財務優勢，為有關基礎設施提供專業知識。然而，政府提供的出口信用保險至為重要。

此外，在眾多的基礎設施工程中，要達至可持續發展，綠化環境是重要的一環。現代生活產生了很多垃圾，妥善處理廢物有助可持續發展。WtE（垃圾焚燒發電），為新興的轉廢為能的技術名詞，這技術能以一千度高溫、廿四小時焚燒垃圾的方法，以所排出的蒸氣製造大量的電力。

總括而言，省港澳不論在金融、政治及科技管理上都有能力為祖國的「一帶一路」政策作出貢獻。

予我而言，OBOR的解釋應該是"Our Bulldozer and Our Rolling stock"（我們的推土機，我們的列車），這是令美國人及日本人羨慕不已的難得機遇。

主題報告 – 一帶一路下大灣區可持續發展機遇與挑戰
Keynote Presentation – Opportunities and Challenges of Sustainable Development in the Pearl River Delta Bay Area under the Belt and Road Initiative

鄭文聰教授，榮譽勳章　太平紳士
正昌環保科技(集團)有限公司　董事總經理
香港工業總會　主席
香港環保產業協會　會長

簡歷

鄭文聰教授、太平紳士現為正昌環保科技(集團)有限公司董事總經理。1981年畢業於美國加州理工大學工業工程系並與2014年位列榮譽校友(Hall of Fame)。自1993年起一直從事於環保工業，主力研究發展廢油再生和工業污水處理技術。他是香港工業總會主席、香港環保產業協會創會會長、商界環保協會董事會成員、香港綠色策略聯盟副主席。鄭教授是香港工程師學會資深會員、香港專業註冊工程師。此外，他亦是香港政府能源諮詢委員會成員、工業貿易諮詢委員會委員、香港政府創新及科技基金—(環保專案)評審委員、水資源與水質諮詢委員會委員、經濟發展委員會委員、回收基金諮詢委員會、香港貿易發展局理事會成員。鄭教授也曾任香港生產力促進局理事會成員(2009–2015)、職業訓練局理事會成員(2011–2015)、香港廢物管理學會會長。

摘要

工業新動向 – 工業可持續性

工業4.0或再工業化是最近成為一個新的詞彙，但其實工業4.0是代表什麼？會為工業帶來一個怎麼樣的新發展？

再工業化其實是將製造技術和資訊技術融合，為工業界進行一場重要的變革。各個發達國家的工業已經開始引入物聯網及機器人於生產線，利用新技術去跳出現有的框架，能更有效益的提供產品或服務和開拓新機遇。另外，共享經濟亦是一個新的工業發展方向，同時亦讓傳統工業能持續地發展。

主題報告－ 一帶一路下大灣區可持續發展機遇與挑戰
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史海鷗先生
廣州地鐵集團副總工
廣州地鐵設計院總工

簡歷

廣州地鐵設計研究院有限公司是國內城市軌道交通綜合設計實力最强的企業之一，業務遍及國內30個城市及海外，截至目前已完成全國40多條城市軌道交通綫路總體總包設計，設計車站超過400座、區間里程超過500km。史海鷗先生現任廣州地鐵集團副總工、廣州地鐵設計院總工，現年51歲，研究生畢業，國家一級注冊結構工程師，教授級高工。參加工作27年來，一直奮鬥在工程設計第一綫。

史海鷗先生作為技術負責人完成了7項大型工程的設計，作為專業負責人完成了2項大型工程的設計，項目技術水準都達到了同期同類項目的國際先進水平，經濟、社會和環境效益十分顯著。

史海鷗先生作為項目技術負責人完成的廣州地鐵二號綫首期工程在國內率先采用剛性接觸網、屏蔽門、非接觸式IC卡和複合地層盾構等先進技術；在設計過程中，他在國內首次提出了地下車站采用全包防水隔離層的設計理念、首次采用結構風管設計、國內盾構隧道首次采用1.5米寬管片和三元乙丙橡膠防水密封墊；車站裝修采用標準化、模塊化、模數化、工業化等在全國地鐵普遍采用。5名院士和11名全國知名專家組成的科技成果鑒定委員會認為：廣州地鐵二號綫的技術水準處于國內領先地位，在總體上接近國際先進水平，為我國城市軌道交通的建設提供了成功的範例，對我國城市軌道交通整體水平的提高和發展起到了促進作用。該項目也因此獲得了全國優秀工程設計銀獎。

史海鷗先生作為設計總體，參與了“廣州地鐵二號綫節能、環保和安全技術集成與應用”科技攻關，通過科技創新節省工程投資約17.6億元，該項目榮獲了國家科技進步二等獎。他在項目中牽頭攻克了剛性接觸網牽引力計算和安裝、屏蔽門結構三維受力計算和抗風壓計算、集中供冷珠江江中取水等系列技術難題，他成功解決了剛性接觸網、屏蔽門安裝與風管接口難題，目前已成為我國地鐵設計通用標準。該項目也是我國地鐵行業第一個綜合性項目獲得國家科技進步獎。

史海鷗先生主持了“廣州市軌道交通二、八號綫延長綫”工程設計，國內首次成功實現對大客流運營綫路僅停運3天即完成綫路拆解調試，并實現2條綫路高服務水平的獨立運營，項目成果達到了國際先進水平。

近幾年他主持的大型項目獲得全國優秀工程設計行業一等獎有4個。

史海鷗先生主持了“複合地層盾構施工關鍵技術創新與實踐”科技攻關項目，為複合地層條件下盾構施工技術的發展做出了重要貢獻，研究成果達到了國際領先水平。

他主編了《城市軌道交通結構安全保護技術規範》等3項國家行業標準，參編了《地鐵設計規範》等7項國家規範和標準，為行業技術發展做出了較大貢獻。

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史海鷗先生組織研發了“應用于城市軌道交通的火灾聯動控制系統及方法”等2項發明專利和7項實用新型專利。他組織完成“廣州地鐵換乘車站綜合設計技術”等12項新技術推廣應用。他編著或合著了《城市軌道交通項目總體總包管理指南》等5部專著。

史海鷗先生是我國城市軌道交通領域知名專家和技術帶頭人，被國內多個城市聘為地鐵建設顧問專家，在國內城市軌道交通設計審查時經常擔任大組長或土建組組長，他也是住建部城市軌道交通工程質量安全專家委員會專家，曾榮獲首届“全國勘察設計行業科技創新帶頭人”等榮譽，具有深厚專業理論功底和豐富的實踐經驗，成績卓著。

摘要

廣州城市軌道交通的可持續發展

城市軌道交通的迅猛發展是中國社會城市化和城市大都市化步伐加快的象徵，不僅被國內外許多城市的實踐經驗證實是解決城市交通擁堵問題的良方，而且城市軌道交通能够極大的改善城市的經濟格局，帶動相關產業的繁榮。

廣州市已經擁有了相當規模的城市軌道交通，目前正在開展新一輪大規模城市軌道交通建設。

本演講將探討城市軌道交通可持續發展的幾個方面：概述城市軌道交通可持續發展的因素、管理政策、技術政策；介紹廣州市城市軌道交通的發展現狀和下一階段建設規劃；針對目前廣州市城市軌道交通發展過程中存在的主要問題，進行分析；針對廣州市城市軌道交通投資、建設、運營期間影響可持續發展的幾個突出問題進行分析；對廣州市城市軌道交通可持續發展的管理政策和技術政策進行分析；探討廣州地鐵對國內外的業務擴展問題(如設計、監理、培訓等)；提出城市軌道交通可持續發展的建議；必要時介紹工程實例。

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Keynote Presentation – Opportunities and Challenges of Sustainable Development in the Pearl River Delta Bay Area under the Belt and Road Initiative

溫日明講師
澳門大學土木及環境工程系高級講師，
澳門特別行政區

簡歷

現職澳門大學土木及環境工程系高級講師，並為澳門特別行政區城市規劃委員會委員。他從事有關運輸規劃以及交通工程之教學及研究工作。其研究範圍包括有運輸需求分析、運輸工具選擇分析、泊車供需研究以及生態交通研究。他曾參與不少有關澳門本地運輸規劃(“澳門交通出行調查”及"澳門泊車研究”等)的研究工作。

摘要

澳門大學新校園位於橫琴島東部邊緣，面積佔地約一點一平方公里，比原校區大二十倍。新校區已蓋建八十多座建築物，可容納一萬二千名學生。澳門與新校區之間交通是由一條一公里多長的河底隧道連接，從澳門一方可全天候隨時進出校園，並必須由原隧道離開，形成一種半封閉校園交通模式。就澳門大學校園交通模式，本文探討可持續發展在大學校園交通運輸規劃及管理的適用性。透過問卷調查，了解學生在校園交通出行的特性，從而討論一些綠色交通運輸管理方法在大學校園實施的可行性。為了更好地了解可持續發展與校園交通運輸之關係，本文嘗試建立可持續校園運輸的研究框架，分別從行人友善校園、環境友善校園、校園基礎設施、綠色出行行為四方面建立指標進行探討及分析。藉由此可持續校園交通運輸指標之建立，以供後續政策制定及其它地區校園交通運輸管理之參考。

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凌嘉勤先生，JP
規劃署署長

簡歷

凌嘉勤先生是專業城市規劃師，實務經驗豐富廣泛，曾參與新機場和東涌新市鎮規劃、《城市規劃條例》檢討、海濱規劃和發展、規劃執管和檢控、跨境規劃及新發展區規劃工作。

凌先生現任規劃署署長，統領香港特別行政區政府規劃署，並擔任城市規劃委員會轄下都會規劃小組委員會和鄉郊及新市鎮規劃小組委員會主席。

凌先生於一九八零年取得香港中文大學社會科學學士(一級榮譽)學位，並於一九八三年獲香港大學理科碩士(城市規劃)學位。他是香港規劃師學會資深會員及註冊專業規劃師，擁有中華人民共和國註冊城市規劃師資格。二零零七至零九年間，凌先生出任香港規劃師學會會長。

摘要

從香港城市規劃策略的區域視角看粵港澳大灣區的可持續發展

作為面向全球、定位為亞洲國際都會的香港，一直在推動區域合作和發展上扮演重要的角色。香港與廣東、澳門同處珠江口流域並擁有與區內歷史文化和經濟發展的深厚淵源，早於2006年便與廣東省、澳門行政特區政府聯合開展《大珠三角洲城鎮群協調發展規劃研究》，並促成2009年三地政府進一步開展《環珠江口宜居灣區建設重點行動計劃研究》。香港在城市規劃方面將繼續推行短、中、長期的規劃工作，提供優質的經濟用地及宜居環境，建設便捷的海陸空交通網絡，與環珠三角的城市開拓新的跨界交通連接，便利區域內外以及通向全球的經濟流動，使香港能持續提高全球及區域競爭力，推動經濟發展和創造就業機會；亦藉「一帶一路」發展策略帶來的機遇，走向新的發展台階，協力推動粵港澳大灣區的可持續發展。

閉幕主題報告 - 可持續的環境及綠色發展（空氣，水，綠色建築）
Closing Keynote Presentation – Sustainable Environment and Green Development (Air, Water, Green Building)

徐向榮博士研究員
中國科學院南海海洋研究所研究員，博士生導師

簡歷

徐向榮，女，中國科學院南海海洋研究所研究員，博士生導師。研究方向為污染物的生物地球化學過程與海岸帶污染防控技術。2005年于香港大學生態與生物多樣性學系獲得理學博士學位。2010年入選中國科學院海外傑出人才引進計畫(“百人計畫”)到中國科學院南海海洋研究所海洋生物資源可持續利用重點實驗室工作，組建了海洋環境污染與防控技術研究團隊。先後主持或參加10多項國家或省部級科研專案。目前主持國家自然科學基金面上專案、國家重點基礎研究發展計畫和重大科學研究計畫專案(973專案)子課題、中國科學院戰略性先導科技專項子課題、廣州市科技計畫專案。已在國際國內重要學術期刊上發表論文100多篇，其中在Chemosphere, Science of the Total Environment, Environmental Research, Journal of Hazardous Materials, Environmental Toxicology and Chemistry等環境領域國際主流期刊上發表SCI索引學術論文75篇(第一或通訊作者論文48篇)，被SCI總引1700多次，他引1400次，H指數22。出版譯著1本，參編8本英文書籍章節。已培養畢業博士生與碩士生各3名，出站博士後2名，曾獲得2014年中國科學院廣州教育基地優秀研究生導師稱號。

摘要

粵港澳珠江口紅樹林濕地的可持續發展

紅樹林是分佈在熱帶、亞熱帶潮間帶的一種特殊生態系統，有著巨大的經濟價值和生態功能。近年來隨著經濟的發展、工業化和城市化的加劇及人口的快速增加，大量陸源污染物經地表徑流、大氣沉降和雨水沖刷等途徑進入海洋，導致包括紅樹林生態系統在內的近海環境品質退化，給生態安全和人類健康帶來潛在風險。我們以珠江口(包括廣州南沙、珠海淇澳島、深圳福田)紅樹林濕地為研究物件，以典型鹵代有機污染物(HOPs)溴代阻燃劑多溴聯苯醚(PBDEs)、十溴二苯乙烷(DBDPE)、1,2-二(2,4,6-三溴苯氧基)乙烷(BTBPE)、得克隆(DP)、多氯聯苯(PCBs)和滴滴涕(DDTs)為目標化合物，研究了HOPs的時空分佈特徵以及其在底棲生物體中的富集放大效應。結果發現表層沉積物中PCBs, DDTs, PBDEs, DBDPE和DP的濃度範圍分別為0.18-7.11, 1.11-84.1, 1.3-206.0, 0.36-34.9和 0.013-1.50 ng/g 幹重。溴系阻燃劑PBDEs的濃度水準處於世界高值區。毗鄰城市的深圳紅樹林區檢測到最高濃度的PCBs, PBDEs, DBDPE, BTBPE and DP。沉積物中HOPs的組成以PBDEs為主，表明珠江三角洲較高的工業化程度。紅樹林沉積柱芯中PBDEs、DPDPE、BTBPE和DP都呈現快速增加的趨勢，反映了鹵系阻燃劑的使用正在迅速增加。紅樹林中 PCBs, DDTs, PBDEs, DBDPE, BTBPE和DP 的沉積通量分別為 142, 10226, 1962, 245, 4.1 和7.2 ng/cm2。與沉積物中以PBDEs為主的組成不同，底棲生物體中HOPs的組成以DDTs為主。底棲生物體中PCBs, DDTs, PBDEs, DBDPE和 DP的濃度範圍分別為32.1–466, 153–3819, 3.88–59.8, not detected (nd)–30.6 0.18–6.88, ng/g 脂重。紅樹林底棲食物鏈中除DBDPE外，PCBs、DDTs、PBDEs和DP的營養級放大因數分別為2.20、2.83、2.61和2.31，表明這些污染物在食物鏈上具有生物放大效應，需要引起各級管理部門的重視。

閉幕主題報告 - 可持續的環境及綠色發展（空氣，水，綠色建築）
Closing Keynote Presentation – Sustainable Environment and Green Development (Air, Water, Green Building)

陸恭蕙女士，JP
香港特別行政區環境局副局長

簡歷

陸恭蕙於二〇〇〇年成立思匯政策研究所，一直擔任行政總監一職至二〇一二年九月十一日。陸恭蕙於一九九二至一九九七年及一九九八至二〇〇〇年為立法局／會議員，具多年從政經驗。

加入立法局前，陸恭蕙於商品買賣及項目策略的工作中擔任地區性要職。她曾任立法局／會環境事務委員會主席(一九九五至一九九六年及一九九八至二〇〇〇年)，亦創辦或服務於多個香港及海外的非政府組織，關注環境保護、城市規劃及設計，以及平等機會等課題。

摘要

由可持續發展邁向生態文明

現時，可持續發展是世界各地普遍認為正確的發展路向。發展不單是指按本地生產總值升幅計算達致高經濟增長，在環境和社會方面亦須做到可持續發展。也有人提出其他概念，進一步探究發展的重點應當為何。例如「循環經濟」的概念強調經濟活動不應浪費天然資源。事實上，未來的產品設計及生產將會着重產生較少廢物，而在如何使用資源方面，物料重用和循環再用會越來越受重視。此外，中國提出「生態文明」的新概念也是可以理解的。三十五年來，經濟急速發展，很多地方的環境都受到嚴重破壞。過去十年，污染控制的措施已加強，有些地方成效顯著，例如國內經濟最發達的地區之一－珠江三角洲的空氣質素已有所改善。粵港澳三地合作改善區域空氣質素將近二十年，成績有目共睹。主管當局之間有常設的溝通平台，並會進一步擴大和深化交流。「一帶一路」把可持續發展、循環經濟和生態文明建設帶到多個發展中的經濟體。對於其他亦開始走向可持續發展的經濟體，我們可分享所得的專門知識和經驗。中國是主要的技術及產品供應者，而香港在環境管理方面則具備堅實的經驗。隨着國家推動發展「綠色融資」，內地與香港的合作應可為其他「一帶一路」沿線經濟體提供一籃子的知識、產品及服務。陸女士的簡報會介紹具體的合作例子。

劉雲剛博士
中山大學教授
中國地理學會副秘書長
廣東地理學會副秘書長
中山大學地理學院城市與區域規劃系系主任
國家註冊城市規劃師
廣州市政府重大行政決策諮詢專家

簡歷

劉雲剛，1973年生，博士，中山大學教授，中國地理學會副秘書長，廣東地理學會副秘書長，中山大學地理學院城市與區域規劃系系主任，國家注冊城市規劃師，廣州市政府重大行政決策諮詢專家，主要從事城市化與、城鄉規劃與生活空間論的相關教學和研究。

摘要

城鄉生活圈規劃與建設方法芻議

劉雲剛，侯璐璐

（中山大學地理科學與規劃學院，廣東省城市化與地理環境空間模擬重點實驗室，廣州 510275）

由于東西方規劃管治的環境不同，源于西方的規劃和管治理念與當下中國國情和社會發展實際需求並不完全一致。對應于中國的國情條件，其城鄉管治的機制途徑也尚需總結。在此背景下，本研究關注近鄰日本的生活圈建設理念及其實踐，並在此基礎上摸索形成了面向中國城鄉一體化發展的城鄉生活圈規劃建設的基本理念和方法，目前已形成較為詳盡的規劃實施路徑，並在部分地區的新型城鎮化規劃及試點項目中開始實施。本文基于以上實踐，嘗試對生活圈的理念、規劃思路和方法進行總結，基于日本的生活圈規劃組織理念，探討政府、市場、社會共同合作的公共服務供給方式，探索基于生活圈的城鄉管治模式，以期為中國推進城鄉一體化的政策實踐提供借鑒。

關鍵詞：生活圈；城鄉規劃；管治；協作；中國

莊宏曦工程師
奧雅納工程顧問管理咨詢 | 政策與可持續發展主任

簡歷

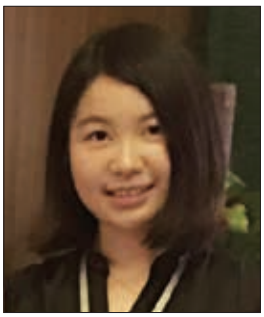
莊宏曦工程師現時是奧雅納管理咨詢部門的主任。他工作的主要范範疇包括制定關於資源效率、綠色基礎設施、和智慧及韌性城市規劃策略。他是奧雅納在東亞區韌性城市與可持續基礎設施的技術領袖，專注於在香港、中國以及其它東南亞國家的總體城市基建規劃、戰略資源規劃和低碳建筑築相關的項目。目前負責的主要項目包括香港政府東九龍智慧城市可行性研究、香港廢物基礎設施規劃、以及中國試點城市循環經濟模型。莊工程師是劍橋志奮領留英獎學金學者，並曾在悉尼大學擔任研究員。他同時也是香港大學土木工程系博士候選人，研究領域為能源經濟學，通過輸入輸出模型來估算全球供應鏈的資源消耗。他並於2013獲取了由香港工程師學會(環境分部)頒發的青年綠色領袖獎。

摘要

智慧、綠色及韌性基礎設施規劃

隨著現代城市化的不斷發展，由於城市人口的急劇增長、氣候的劇烈變化、環境破壞和資源的枯竭，城市在能源、廢棄物以及水源的管理上面臨著日益嚴峻的挑戰。這些危機和挑戰要求現代城市的基礎設施不僅能够有效地收集、整合和高效地處理基礎設施相關的信息，並且需要再規劃中考慮綠色技術在自然的生態系統中的融合與應用，另外需要在規劃中考慮氣候變化對于基礎設施的影響。本文將主要討論智慧、綠色和韌性的理念在基礎設施規劃中的應用，並主要論述關于能源-水-廢棄物的基礎設施的綜合規劃，通過設施間的公用和級聯，以達到整合基礎設施、提高資源總體利用率和優化土地利用的目的。

趙亞蘭博士
中國科學院廣州地球化學研究所
可持續發展研究中心博士



簡歷

中國科學院廣州地球化學研究所可持續發展研究中心博士，重點關注應對氣候變化背景下的能源消費碳排放、生態安全網絡格局等問題。

摘要

Decomposition Analysis in Decoupling Transport Output from Carbon Emissions in Guangdong Province, China

Yalan Zhao [1,2], Yaoqiu Kuang [1] and Ningsheng Huang [1]

[1] Sustainability Development Research Center, Chinese Academy of Sciences, Guangzhou 510640, Guangdong, China

[2] University of Chinese Academic of Sciences, Yuquan Road, Beijing 100049, China

Abstract. With a continuously growing share of the world's overall energy consumption, the transport sector has been acknowledged as one of the most important contributors to global carbon emissions. This paper applies a complete decomposition and decoupling analysis to investigate and quantitatively analyze the main factors influencing the energy-related carbon emissions of the transport (TCE) sector during 1995–2012 in Guangdong, the richest and most populated province in China. Results showed that decoupling level between transport output and TCE was relatively low, especially when compared with year 1995, in which case it remained as expansive coupling. Optimization of tertiary industry structure was the main factor inhibiting TCE increase. However the rapid growth of GDP per capita and population was more powerful at boosting TCE, resulting in elasticity index rising directly. 2005 was a turning point when environmental friendly policies took action, after which decoupling state improved significantly, achieving weak decoupling when comparing adjacent years.

利天佑教授
聖若瑟大學教授及澳門大學博士後研究員

簡歷

利天佑(Francisco B. S. José Leandro)教授，澳門居民，取得政治科學與國際關係博士學位(葡萄牙)；國際法高級文憑(意大利)，軍事和社會科學高級文憑(葡萄牙)；法律本科學位(葡萄牙)，軍事和社會科學本科學位(葡萄牙)；法律顧問文憑(德國)及公共關係顧問文憑(德國)。在2015年，利天佑教授獲得由北京大學／澳門歐洲研究學會所頒授的珠三角國際投資及貿易法律文憑。

利天佑教授曾在各地的大學任教：葡萄牙、安哥拉、意大利、德國、荷蘭、西班牙、法國、中國(澳門)，菲律賓和匈牙利。

利天佑教授曾擔任歐洲委員會及北約的法律顧問，亦曾是歐盟和聯合國的公共關係顧問。他亦是葡萄牙天主教大學政治科學和國際關係博士課程的成員。此外，他廣泛地發表關於國際法，戰爭與性別犯罪，公共傳播，歐盟，國際關係和澳門特別行政區之文章。利教授出版了7本著作，而且亦在歐洲和亞洲的報紙發表眾多的評論文章，例如：中國日報香港版。自2012年以來，他在聖若瑟大學(澳門)擔任助理教授，亦是澳門大學的博士後研究員(中國)及澳門歐洲研究學會的客席教授(中國)。

摘要

「一帶一路」在大珠江三角洲區域對澳門特別行政區的地緣政治優勢

本文的主要目的是從地緣政治／地緣經濟的角度去釐清澳門特別行政區在「一帶一路」倡議下的任務及所扮演的角色。因此，本文將分為以下數章：

甚麼使「一帶一路」倡議與別不同？「一帶一路」是否重塑未來的地圖？甚麼可能令「一帶一路」蒙上陰影？澳門特別行政區在「一帶一路」的背景下應扮演甚麼角色？甚麼推斷「一帶一路」與別不同？

事實上，「一帶一路」倡議在區域間的發展開放給所有的國家合作，並將其與中國區域發展規劃相結合，是可以預見澳門特別行政區從中所擔當的角色，作為一個有功能性的軟實力，在南大西洋地帶下－作為七個經濟共同體的地緣經濟軸。(東協、歐盟、南方共同市場、南部非洲發展共同體、西非國家經濟共同體、中非國家經濟共同體和東非共同體)。

其實，本文得出的結論是這種功能性的軟實力是建基於四個方面：地理位置、文化遺產、專業化的「技術」及國際法律地位。

吳兆堂教授
香港大學土木工程系

簡歷

吳兆堂教授是香港大學土木工程系教授及該大學基建及建造業發展研究中心之行政總監。多年來，吳教授獲得6千萬港元以上的研究經費，而他亦發表了超過330篇的學術文章。他最新的研究方向包括智能和韌性城市、可持續建築環境、基建設施管理、建築信息化、建築效率和績效、項目交付系統、等。

徐軍博士
香港大學土木工程系博士後研究員

簡歷

徐軍博士，香港大學土木工程系博士後研究員。2003-2013年任香港大學電子商業科技研究所研究項目經理和高級資訊經理。近年來，作為首席項目研究員、主要技術負責人或主要研究人員，領導或參與多項香港科技創新基金項目、香港研究資助局優配研究金項目、粵港關鍵領域合作項目及相關國家項目的研究和開發，主要負責項目管理、架構設計、關鍵算法研究等。徐博士有超過15年的IT從業經驗，先後在國內知名IT公司和研究機構擔任高級軟件工程師、系統分析員等職務。徐博士1998年獲北京大學計算數學專業博士學位，是多項軟件著作權或專利的核心作者，有近20篇會議或期刊論文在國內外雜志和國際會議發表。徐博士目前的研究興趣包括：可持續發展、社區和城市韌性、智慧基礎設施、智慧城市、物聯網、大數據、供應鏈管理等。

摘要

國家推動的‘一帶一路’戰略明確要求各級政府要充分發揮深圳前海、廣州南沙、珠海橫琴等開放合作區作用，深化粵港澳台合作，推進區域重大基礎設施建設，優化區域經濟格局，構建世界級城市群，打造粵港澳大灣區。這不僅為大灣區的經濟發展帶來前所未有的歷史機遇，同時也為大灣區的可持續發展帶來重大挑戰，其中如何增強區域和城市韌性是大灣區城市必須共同面對和解決的問題，以提高應對氣候變化、極端天氣、自然災害以及其他人為破壞的能力。

本文基於政府制定公共政策參考的執政資源模型(NATO)提出了一個分析和比較城市韌性政策的基本框架。大灣區不同管理模式的城市可以使用該框架分析和比較現有城市韌性和可持續發展政策工具的不足和共同點，探討和協調增強整個大灣區城市群韌性和可持續發展的策略和路線圖，在區域和城市層面努力實現《巴黎協定》、《2015-2030年仙台減少災害風險框架》、《變革我們的世界：2030年可持續發展議程》等國際公約中達成的2015後可持續發展目標。

毛豔華教授
中山大學粵港澳研究院教授
中山大學自貿區綜合研究院副院長

簡歷

中山大學自貿區綜合研究院副院長，港澳珠江三角洲研究中心教授、博士生導師，粵港澳發展研究院海上絲綢之路與粵港澳國際合作研究中心主任。兼任中國自由貿易試驗區協同創新中心學術委員會委員、廣東海上絲綢之路研究院學術委員會委員等職務。先後在香港中文大學、早稻田大學和紐約大學等海外高校進修與高訪。主要研究方向為國際貿易、空間經濟和港澳珠三角經濟。主持國家社會科學基金、教育部人文社科基金、打造“理論粵軍”重大項目以及政府招標課題，在《經濟研究》、《經濟學家》、《財經研究》、《學術研究》、《中國軟科學》等刊物發表學術論文30餘篇，出版《香港對外貿易發展研究》、《產業分工、區域合作與港澳經濟轉型》、《珠三角自主創新能力研究》等專著3部，2次獲得廣東省哲學社會科學優秀成果獎勵。

摘要

“一帶一路”與香港經濟第三次轉型

毛艷華
中山大學／粵港澳發展研究院
廣東廣州／中國

榮健欣
中山大學／港澳珠三角研究中心
廣東廣州／中國

新世紀以來，香港經濟進入了第三次轉型時期。從經濟發展和產業結構變動的特徵來看，香港經濟第三次轉型主要發生在服務業內部，並進一步呈現出經濟服務化趨勢、主要行業向高增值環節轉型升級和經濟功能向離岸服務角色演變等三方面特徵。在內地加快構建開放型經濟新格局的背景下，“一帶一路”建設機遇能够不斷强化香港作為亞洲乃至全球價值鏈管理樞紐的地位，將為香港成功實現第三次經濟轉型提供巨大動力。因此，“一帶一路”建設與香港經濟的長遠發展戰略相一致，香港應積極主動參與“一帶一路”建設。

程明錦先生
莫特麥克唐納部門董事

簡歷

程明錦是一名註冊工程師，並擁有二十九年環境顧問和工程項目的專業經驗。他曾經領導和管理多項顧問項目，包括多個大型基建項目的環境影響評估、環境檢閱、環境監察和審核以及獨立的環境查核人。程先生亦就可持續發展策略、清潔生產技術和防止污染及能源效益(P2E2)技術進行了不同的環境研究，以及為制定污水收集整體計劃和廢物處置計劃進行環境調查。在加盟莫特麥克唐納之前，程先生曾於澳洲的維多利亞省環境保護局工作，作為工業設施審核的組長，他主要負責根據環境保護條例1970的規定委任和監察環境審核員的技術表現，以及就實施規管和法定環境審核的應用等方面提供技術諮詢。

摘要

發展智能城市以滿足珠三角地區的未來需求

迅速的城市化發展將會在能源、水、廢物、交通、衛生、電信和建築環境等領域帶來挑戰。智能技術和創新的基礎建設解決方案能有效地幫助處理城市的人口增長問題，並有助這些城市繼續保持繁榮、宜居及充滿活力。本演講將涵蓋智能城市的關鍵概念，並提供世界各地發展項目的智能方案案例，以供珠三角地區參考。我們必須建立合作框架，以協助工程師、規劃師、建築師和設計師，為滿足未來社區所面對的社會和基礎建設需求共同努力(將提供案例參考)，以確保一個可持續發展的未來。

馮永業先生
香港機場管理局企業發展執行總監

簡歷

馮先生持有社會科學學士(一級榮譽)學位。馮先生於2010年8月獲機場管理局委任企業發展執行總監。加入機場管理局前，馮先生於2006年至2010年期間擔任香港生產力促進局總裁。他擁有20多年公共行政經驗。他於1985年加入政府出任政務主任，曾在政府多個決策局及部門服務，經驗豐富，工作涉及的範疇包括航空服務、地政與城市規劃、房屋政策、消費者保障及競爭政策。

摘要

「一帶一路」發展下香港國際機場面對的機遇和挑戰

作為南中國面對世界的窗口，香港國際機場在「一帶一路」戰略的實踐中扮演著重要的角色。為了配合整體需求和發展，香港國際機場今年會開始擴建成為三跑道系統。可是擴建需約八年時間，面對亞太地區各個機場正積極擴建，以及中東航空業高速發展，香港國際機場不但會積極提升機場的地面和客運設施的處理能力，同時亦會引入新技術，藉創新及科技發展以加強機場的效率及服務質素，提升旅客體驗，提高競爭力。近年香港國際機場在中國內地的腹地市場快速拓展。港珠澳大橋、廣深港高速鐵路等主要跨境及本地基建項目，將會為香港國際機場帶來更多的機遇和挑戰。香港機場管理局企業發展執行總監馮永業先生會在研討會上介紹在"「一帶一路」發展下香港國際機場面對的機遇和挑戰"。

分題報告－環境 Built Environment, 綠色發展綠色建築
Speaker Presentation – Built Environment, Green Development Green Building

陳永康工程師
香港綠色建築議會執行董事

簡歷

陳永康為香港註冊工程師，現擔任香港綠色建築議會執行董事。他多年來致力研究工作，實現種種節能措施，於提升建築物能源表現範疇成果卓著，並屢獲國際殊榮，包括2010年由英國特許屋宇設備工程師學會頒發的「低碳營運大獎」。陳永康又積極參與專業團體與商界活動，貢獻一己專長。

摘要

香港可持續發展的獨特優勢及國際經驗

香港於可持續發展領域上擁有豐富知識及經驗。位處中國東南方珠三角地區，香港是內地對外開放的重要門戶，吸引大量外資及技術流入，加上各界多年研究綠色建築及設計等的經驗，使香港成為世界上少有的高密度發展都市，於可持續發展模式及能源效益上均得到國際認同，成為地區上可持續發展的典範。本文將論述香港多年來於城市規劃及配套、專業知識、人才培訓和與環境評估相關法律制度的可持續發展經驗及技術。文章亦會闡述香港如何活用參與國際基建及建築發展項目的經驗和技術，把握一帶一路的機遇，配合珠三角地區的可持續發展，共建綠色經濟體系。

關鍵字：可持續發展、環境評估、一帶一路、珠三角

李建新博士
廣東省建築科學研究院集團股份有限公司
建材事業部主任

簡歷

廣東省建築科學研究院集團股份有限公司建材事業部主任、工學博士,2011年畢業于華南理工大學，從事高性能水泥基複合材料的科研和學習工作，近年來，參與國家、省部級重大科研項目數十項，在國內外重要學術刊物及會議上發表論文二十餘篇，其中，被SCI、EI收錄6篇；授權國家發明專利五項，主編、參編國家、行業、地方標準近二十本，多次獲廣東省土木工程學會科技進步獎、廣東建工集團科技獎及建科院先進個人等榮譽稱號。

摘要

綠化節能一體化現澆輕質混凝土墻體施工工藝研究

李建新，陳培鑫，費飛龍，陳耿

以梁、柱作為支撐點，采用鋁模作為模板，墻體植筋與柱連接，預埋綫盒、管綫和預留孔洞、門窗，門窗洞口設置過梁，采用預拌砂漿，現場利用發泡裝置製備出輕質混凝土，並通過泵送設備將輕質混凝土澆注在模板當中，自然養護而成，實現了輕質墻體機械化施工和水電土建集成化作業，墻體質量穩定、施工便捷，同時實現了墻體節能、防火隔聲、平整度好、免抹灰、管綫預埋、吊挂强等。

分題報告－環境 Built Environment, 綠色發展綠色建築
Speaker Presentation – Built Environment, Green Development Green Building

陳國華先生
中華電力有限公司工程項目總監

簡歷

陳國華工程師1989年畢業於香港理工大學，持有電機工程系學士學位，隨後加入中華電力有限公司。擁有超過25年電力工作經驗，先後任職不同部門，負責電網規劃及運行管理、資源規劃與政府規管統籌、輸電及供電業務部整體安健環質管理及策劃。現職為工程項目總監，負責輸電網絡的工程發展及興建，以滿足電力供應增長及維持電網穩定。陳先生同時是特許工程師，亦是工程及科技學會香港分會的活躍會員。

何兆光先生
中華電力有限公司資產管理總監

簡歷

何兆光工程師於香港大學電機及電子工程學系畢業，獲學士學位。本科畢業後加入香港中華電力有限公司工作。先後任職於多個部門的不同專業，包括電網調度、運行方式、電網規劃、電能質量、輸配電設備規範及工程項目管理等。現任的職位為資產管理總監，負責制定輸配電網資產的規劃及營運策略。何工程師是香港工程師學會資深會員。

摘要

可持續發展變電站：環保及應對氣候變化的電力供應

可靠而具成本效益的供電，對促進香港經濟發展及保持競爭力不可或缺。中華電力有限公司(下稱中華電力)致力為香港八成以上的人口提供優質的電力供應，滿足本地的電力需求。

保護環境是中華電力的核心價值之一。隨著更嚴謹的法例規管，及公　對企業環保表現的期望不斷增加，中華電力主動采用全面及可持續發展的策略，令輸電網絡的發展更為環保。

面對不斷轉變的電力操作環境，中華電力成功建立系統性及創新的環保策略，用以設計及興建變電站。

有關策略包括制訂完善的環保變電站設計規程及指引。透過在變電站的設計、興建及運作上實踐環保，包括在選址、間格設計、綠化元素、能源效益及室內環境質素控制管理方面不斷改進，中華電力新建的變電站與周圍環境更為融合。此外，透過更換或取代燈具、機械通風系統及隔音屏障等，變電站的碳足印亦成功大幅減少。

至於施工過程，中華電力與承建商及電力設備供應商，以協作模式推行綠色建造管理措施，並於建築設計及規劃過程中採用建築信息模擬(BIM)技術，使環保及施工安全管理方面更見效益。

因應氣候變化及極端天氣對變電站所帶來的風險，中華電力在設計變電站時，致力加强應對惡劣天氣的措施，當中包括加裝抵禦風暴潮及海平面上升的設備與預警系統。同時，中華電力為變電站進行詳細的風險評估，配以完善的抵禦、延緩及損壞控制措施，加强高水浸風險變電站的應對能力。

上述變電站設計、興建及運作方面的策略及措施，充分反映中華電力致力為客戶提供安全及可靠電力供應的承諾。

許燕祿先生
廣東省建築科學研究院集團股份有限公司
總工室主任助理
教授級高級工程師
一級註冊結構工程師

簡歷

廣東省建築科學研究院集團股份有限公司總工室主任助理、教授級高級工程師、一級註冊結構工程師，主要從事綠色建築、建築節能等技術的設計和研究。

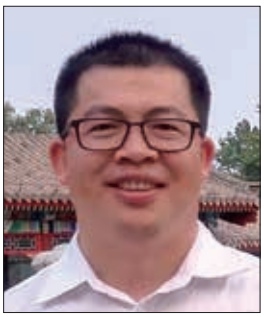
摘要

建築餘泥渣土受納場建設管理技術調研以深圳、香港建築餘泥渣土受納場為例

許燕祿　　陳茜　　劉遠亮
總工室／廣東省建科院　設計院／廣東省建科院　地基二所／廣東省建科院
廣州／中國　　廣州／中國　　廣州／中國

城市建設中對建築餘泥渣土的處理和受納是一直存在的，但築餘泥渣土受納場建設技術規範目前在國內尚屬空白。隨著城市綠色建設要求的提高，編制建築餘泥渣土受納場建設標準變得非常迫切。為此，編制組對深圳和香港幾個類似功能的場所開展了調研，從規劃、建設和運營等方面瞭解和總結一些技術措施，以便高質量完成廣東省住房和城鄉建設廳下達的標準編制任務，為城市綠色建設提供技術支撐。

葉有華博士高級工程師
深圳市環境科學研究院生態所所長
深圳市自然資源資產核算與評估中心主任



簡歷

深圳市環境科學研究院生態所所長、深圳市自然資源資產核算與評估中心主任，主要從事城市生態、生態審計相關的規劃研究與諮詢工作。

摘要

以“兩山論”爲指導，探索編制自然資源資產負債表

葉有華，張原，孫芳芳，李鑫，陳龍，尹雪
深圳市環境科學研究院／深圳市自然資源資產核算與評估中心廣東深圳，518001

人與自然和諧共處、經濟與社會和諧發展是提升民生福祉、建設美麗中國的重要保障，是開展生態文明建設，實現中華民族永續發展的根本要求。早在2006年，習近平總書記就提出了“綠水清山就是金山銀山”的科學論斷，明確了經濟發展和環境效益之間的依存關係，闡述了人與自然和諧相處、經濟與社會和諧發展的科學理念。2013年總書記又將此理念進一步歸納為“兩山論”，即“既要金山銀山，又要綠水青山，綠水青山就是金山銀山。”

根據“兩山論”的科學理念，十八屆三中全會提出了探索編制自然資源資產負債表，對領導幹部實行自然資源資產離任審計的戰略要求。黨中央、國務院分別于今年5月和7月相繼印發了《關于加快推進生態文明建設的意見》和《黨政領導幹部生態環境損害責任追究辦法(試行)》，進一步明確了通過對自然資源資產的核算與審計、對生態環境損害責任追究來實現保護資源環境的目標。

當下，正值《綠水清山就是金山銀山》發表十周年之際，回顧在“兩山論”的指導下一年多時間裏探索編制深圳市和深圳所轄的兩個區自然資源資產負債表過程，提出幾點關于自然資源資產負債表編制的思考及建議，以期為我國其它地區自然資源資產負債表編制、黨政領導幹部自然資源資產離任審計、生態環境損害責任追究、生態文明建設和環境執法提供參考。

分題報告－可持續的能源供應與使用及氣候變化的挑戰與機遇
Speaker Presentation – Sustainable energy, Water supply, and Use of Challenges and Opportunities from Climate Change

陳漢輝博士工程師
水務諮詢委員會主席
漢臻顧問有限公司董事總經理

簡歷

陳漢輝擁有超過33年環境管理，環境評估及工程管理經驗。現任職香港的 [漢臻顧問有限公司] 董事總經理。曾擔任不少香港大型基建工程的環境評估、如數碼港發展、迪士尼基建發展、青馬橋、啟德體育園區發展等工程。

在推動內地環保工作方面，陳博士曾于九十年代致力向深圳城管辦推介先進的垃圾填埋技術，並曾多次擔任深圳城管辦的垃圾專家小組組員。

陳博士參於不少公職, 現為水務諮詢委員會主席、創新及科技基金委員-環保技術的評審委員, 及空氣污染管制上訴委員。二〇一五年被委任擔當調查食水含鉛量超標專責小組成員及二〇一六年被委任為食水安全國際專家小組成員。

另外，陳博士亦曾參於香港大學，香港科技大學及城市大學本科及碩士課程。現為香港大學的客座副教授及香港高等科技大學兼任教授。

摘要

香港政府於2008年推行《全面水資源管理策略》(《策略》)，重點是「先節後增」。前者透過各項節約用水的措施控制用水需求的增長。而後者透過發展海水化淡、再造水、以及洗盥水回用和雨水集蓄，逐步將現時三個水源(本地收集的雨水、輸入的東江水和沖廁用的海水)擴展至六個水源的供水格局，加強香港的供水安全及應變能力。政府現正進行顧問研究檢討《策略》，以便制定新的水資源管理措施，為應付難測的氣候變化和挑戰作好準備。本文章將闡述香港未來水資源所面對的挑戰，並分享講者對水資源管理的見解。

郝全成高級工程師
南京大學氣象學碩士

簡歷

就職于廣東省氣象局氣候中心剛滿10年，主要從事氣候監測、預測及氣候變化研究工作。郝全成對影響華南尤其是廣東不同年代際、年際、季、月及延伸期尺度氣候的外强迫及環流因子等有著深刻認識，多次在灾害性氣候事件、轉折性氣候趨勢和重大天氣預報保障服務中預報準確，近5年中，3次獲得年度“優秀預報員”稱號，2013年和2014年還分別獲得强颱風“尤特”和超强颱風“威馬遜”氣象預報服務先進個人。

摘要

氣候變化背景下廣東近10年冷冬頻發成因分析

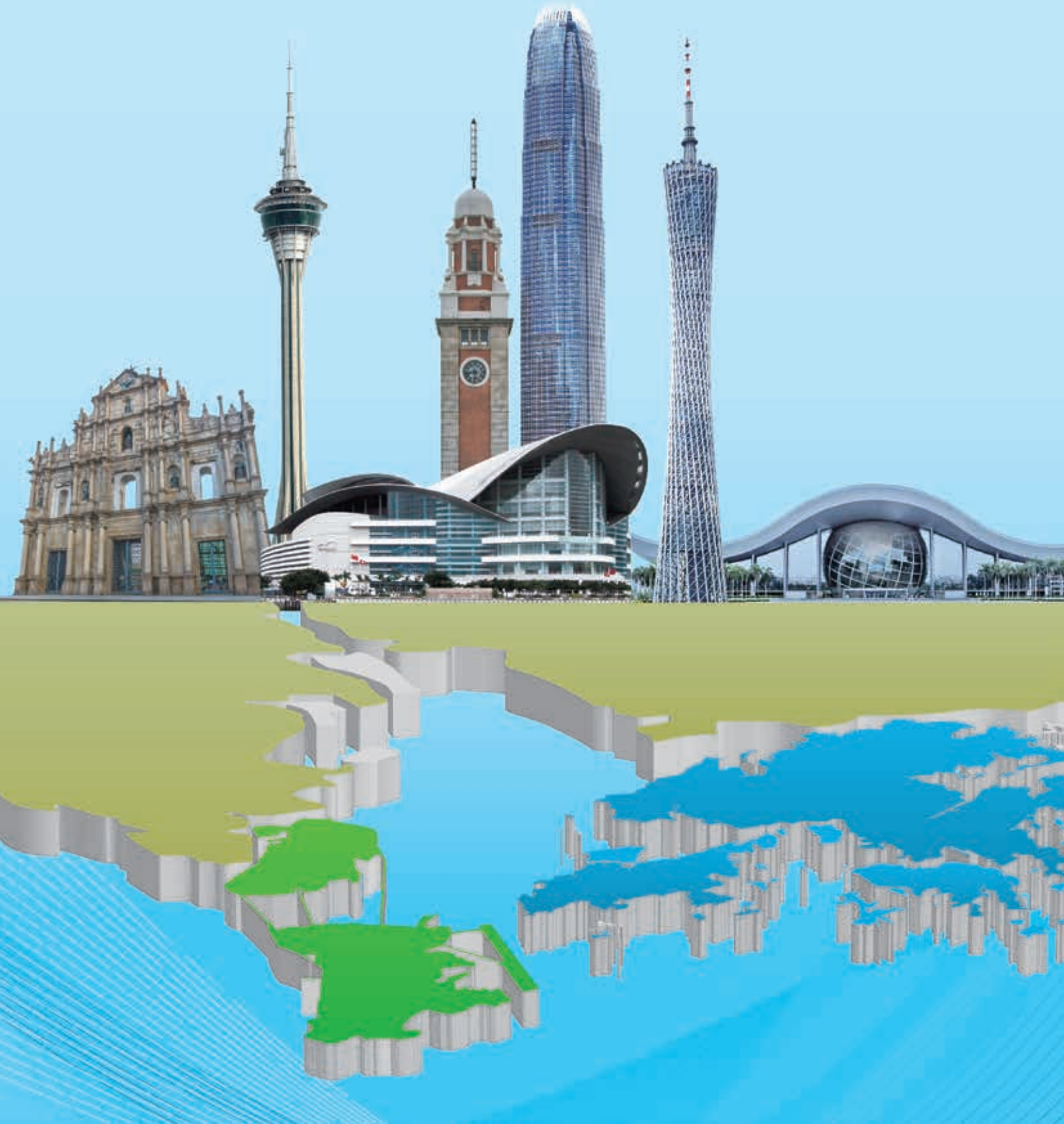
郝全成、杜堯東、胡婭敏、王娟懷、李芷卉

廣東省氣候中心，廣州 510080

利用1951-2015年廣東86站逐日氣溫資料，分析了近65年廣東冬季氣溫變化趨勢，發現廣東冬季平均氣溫增速為0.13/10a，但近10年冬季平均氣溫呈明顯下降趨勢。本研究定義了我省冷冬、暖冬劃分標準，發現近65年冷冬年數（21年）是暖冬年數（7年）的3倍，近10年我省有4年屬冷冬年份。近10年冷冬頻發的成因：（1）PDO年代際振蕩從正位相轉為負位相導致的西伯利亞高壓增强是近10年冷冬頻發的重要原因；（2）近15年全省55個站點搬遷帶來的累積影響是冬季氣溫下降的重要人為因素，對比觀測表明，韶關、廣州、深圳、湛江等傳統代表站遷站後4站冬季平均氣溫距平平均下降約0.9℃；（3）全省平均冬季平均氣溫的新氣候平均值（1981-2010）比前值（1971-2000）升高了0.3℃，它的啓用使得我省更容易達到冷冬標準。

關鍵詞　冷冬；氣候變化；PDO；氣候平均值；

研討會講者論文集
Full Papers of Speakers



「第八屆粵港澳可持續發展研討會 • 一帶一路下大灣區可持續發展機遇與挑戰」致辭
《粵港澳合作推動大珠三角綠色智慧城市發展》

盧偉國博士工程師SBS,MH,JP
香港綠色策略聯盟主席

各位主禮嘉賓、各位嘉賓、各位朋友，大家好！

本人應邀參與「第八屆粵港澳可持續發展研討會」，與大家探討如何應對一帶一路下大珠三角區域可持續發展所帶來的機遇與挑戰，合作推動綠色智慧城市的發展，十分榮幸！

今屆里約奧運開幕式給我留下深刻的印象，既表現巴西獨特的文化，又涉及全人類都關注的一個主題——環保。大螢幕上的投影展示了近年來二氧化碳增加、冰層融化和全球變暖的影像，觸目驚心。該環節以一個小男孩種下一棵樹苗結束，代表新希望。

聯合國「政府間氣候變化專門委員會」（IPCC）2013年發表了一份評估報告，指出大氣中二氧化碳濃度是391ppm，比前工業化時期的水準超出約40%。自從工業革命以來，由於化石燃料的排放，大氣中二氧化碳濃度持續增加。如果不努力遏止排放，大氣中二氧化碳濃度在2030年可能超過450ppm，在2100年，更可能達到750ppm以至超過1300ppm的水準。

在香港，溫室氣體排放的主要源頭是發電，大約佔總排放量的三分之二，而接近百分之九十的電力都是用於建築物之內。換言之，建築物所耗用的能源約佔香港溫室氣體總排放量的百分之六十。因此，為有效控制香港的溫室氣體排放量，有必要探討綠色建築的發展。「綠色建築」是指能夠減少建築物對環境影響的建築作業模式，由建築物的選址、設計、施工、營運管理以及保養等環節，都貫徹善用能源和其他資源，並減少產生廢物和污染，有效減少對環境的影響。

香港綠色建築議會在2013年推出「香港3030」計劃，以2005年用電量為基準，訂出明確的發展藍圖，目標是在2030年將全港建築物耗電量降低30%，將香港建設為低碳及可持續發展城市。此外，綠建環評BEAMPlus認證亦受到歡迎，截至今年8月1日止，已登記綠建環評項目總數已達到854個。

本屆特區政府在2013年成立了「推動綠色建築督導委員會」，就推動綠色建築制定實施策略，包括在啟德發展區落實設置區域供冷系統。本人作為《區域供冷服務條例草案》法案委員會主席，對於該條例在立法會順利完成審議並通過，十分欣慰。區域供冷系統具有較大的能源效益，與傳統氣冷式空調系統比較，可節省三成五用電量。該系統還可以減少總建築成本約百分之五至十。我建議特區政府在這個試點項目取得經驗後，以及在規劃其他新發展區時，推廣類似的綠色建築規劃元素。

綠色建築在內地亦發展迅速。由於各類建築物大約佔內地能源消耗的25%，國家從2006年開始推行「綠色建築標識」三星級評價系統，截至去年底，全國綠色建築標識項目累計有4,071個，建築面積達47,217萬平方米。內地現已成為美國LEED綠色建築認證項目的最大海外市場。今年2月，國家發改委與住房和城鄉建設部聯合宣佈《城市適應氣候變化行動方案》，表明到2020年，要建設30個適應氣候變化試點城市，綠色建築推廣比例達到50%。

隨著科技進步，未來城市發展必然是以人工智慧為基礎。我認為，兩地工程建造業界應致力推動新思維，進一步應用綠色化與智慧化的科技成果。在綠建創新方面，未來有兩大趨勢，一個趨勢是物聯網IoT，涉及到傳感器和傳感器網絡、資訊處理和計算、高速而可靠的資訊通訊網絡等。另一個趨勢是智能建築，以先進的現代建築技術、資訊通訊技術和管理技術，進行最優化的組合，達致可持續發展的目標。

我提倡基建智能化，曾向香港特區行政長官建議，將來規劃新發展區時，要融合「智慧城市SmartCity」元素，完善規劃各種通訊、管網、智慧家居、綠色建築等軟、硬體基建設施，致力打造綠色智慧社區。

據國際上廣泛認同的定義，「智慧城市是新一代資訊科技支撐，知識社會下一代創新（創新2.0）環境下的城市形態」，主要由大數據（bigdata）驅動。香港在建設智慧城市方面，具有不錯的基礎。根據世界競爭力年報，香港的科技基礎設施連續5年排名全球第一。本地研發的光纖監察系統，可用於監察路軌、電纜和管道的狀況，節省基建設施的維修和營運成本，贏得不少國際獎項，獲多個國家和地區採用。今年的施政報告也宣佈，當局將與公私營機構共同研究建設「智慧城市」，制定相關的數碼架構和標準。

國家在今年3月公佈了「十三五規劃」綱要，提出積極應對全球氣候變化，加大低碳技術和產品推廣應用力度。第三十四章強調要「建設和諧宜居城市」，實行綠色規劃、設計、施工標準，建設綠色城市，並加強現代資訊基礎設施建設，推進大數據和物聯網發展，建設智慧城市。第五十四章專門提出要深化內地和港澳的合作，推動粵港澳大灣區和跨省區重大合作平台建設，並支持港澳參與「一帶一路」建設，為促進粵港澳合作提供了國策上的支持。

「一帶一路」沿線國家無疑對基建有龐大的需求，而這些建設必須是可持續的、綠色的。我們應利用這機遇，發揮香港和內地的專長，攜手推動綠色建築，綠色智慧城市群。

香港既是「五流」匯聚之地，「五流」是指人流、物流、資金流、資訊流、服務流，又在工商貿易、工程、建築、金融、法律、會計、科技創新及應用等專業服務均達到國際水準，有條件在多個領域擔當「超級聯繫人」的角色，可搭建不同的平台，例如集資融資平台、高端專業服務平台、新興產業平台、商貿促進平台等，發揮強大的合作效益。

香港也積極參與推動區域合作，例如，香港、廣東省和澳門在2012年6月共同發佈了《共建優質生活圈專項規劃》，構建一個低碳、高科技、低污染的優質生活城市群。在2015年10月，我應邀參加了在香港舉行的第十一屆「泛珠三角區域科協及科技團體聯席會議」，該會議歷年在泛珠三角9+2地區輪流主辦。按照「內地與香港關於建立更緊密經貿關係的安排(CEPA)」，香港公司可通過合資或者獨資形式，在內地提供建築、工程、城市規劃及風景園林設計等專業服務。我們應繼續優化和善用這些機制。

香港和內地業界的合作，幅度廣闊，無論是設計、建造、融資和營運，以及在制度上、國際標準上、風險管理上，香港都可以發揮其高增值專業服務的優勢。兩地企業也可以一起參與海外項目。香港的地鐵公司、中華電力公司等，都累積了不少相關經驗。

致力推廣兩地的專業服務品牌，也是重要的合作內容。國家建立了「綠色建築標識」，香港則採用「綠建環評BEAMPlus」認證。在未來，兩地業界可以聯手促進「綠色建築標識」的國際化和國際認可，以及共同制定與「智慧城市」相關的數碼架構和標準。

我深信，今天的研討會可以集思廣益，促進粵港澳的交流與合作，攜手推動「一帶一路」和大珠三角綠色智慧城市群的建設，在經濟發展、環境保護、以及生態保育之間，尋求適當平衡，達致「以人為本」的可持續發展。

謝謝大家！

“十三五”時期粵港澳區域合作趨勢與策略研究

陳廣漢
中山大學／粵港澳研究院
中山大學／港澳珠三角研究中心
廣東廣州／中國

一、“十三五”時期粵港澳合作發展趨勢

1、 經貿合作不斷深化。服務貿易快速增長，服務業合作重要性不斷提升，服務貿易自由化成為粵港澳深化經貿合作的重點。廣東與港澳雙邊服務貿易額保持快速增長，服務業合作將成為未來粵港澳合作的重中之重，其中廣東對港澳的服務輸出在服務貿易中的份額進一步提升。商業存在(即投資)仍是服務貿易的主要形式，而以服務外包和自然人流動形式進行的服務貿易顯著增加、比重逐漸增大。金融服務的合作進一步深化，跨境人民幣貿易和跨境資本流動規模繼續擴大、自由度不斷提升，粵港澳金融市場加速融合；專業服務相關資格互認繼續推進，粵港澳專業人才流動愈加頻繁，越來越多的廣東專業人士進入港澳提供服務。

雙向投資增加，企業整合與產業融合加速。港澳保持對廣東投資增長的同時，廣東對港澳投資顯著增加；通過企業收購、兼並重組等形式粵港澳三地企業進一步整合，出現更多的聯合企業和大型企業。粵港澳在技術創新、企業管理創新方面的合作不斷增加，產業鏈進一步優化；現代產業進一步集聚，廣州、深圳與香港三地逐漸形成具有國際競爭力的服務產業集群。

2. 合作領域不斷拓展。合作領域不斷拓展，合作內容不斷豐富。在經貿合作的基礎之上，粵港澳在社會、民生、安全等多方面的合作內容不斷豐富。教育合作進一步發展，粵港、粵澳合辦學校不斷增加，學術交流與人才交流日益頻繁；港澳獨資職業培訓機構顯著增多，職業教育合作與專業人才聯合培養取得長足進步；產學研合作更加緊密，教育、研發與產業進一步對接。養老、醫療方面的合作有望取得重大突破，港澳投資養老院、療養院、綜合性醫院數量不斷增加，醫療保險有望實現對接。粵港澳安全防控體系進一步升級和完善，在食品安全、公共衛生、社會治安等方面全面實現信息共享，形成共同監管、聯合防控、協同處理的社會安全合作體系。

合作區域不斷擴大。粵港澳合作由主要集中於珠三角地區擴大到整個廣東省，粵東、粵西和粵北區域與港澳的合作得到進一步加強；港澳對上述區域的投資不斷增加，製造業轉移的同時完成轉型升級，充分利用不同地區的優勢，在旅遊、生態農業等方面開展更多的合作。

3. 合作機制不斷完善。建立政府、企業和市場有機結合的多層次的合作機制。首先，發揮市場在區域合作和區域資源配置中的主導作用。市場在合作中重要性不斷提升。粵港澳合作逐漸由市場主導，合作形式、合作對象等基本由市場決定，市場在資源配置中發揮更重要作用，逐漸形成粵港澳統一的資本、知識、技術、信息、產權等要素市場；土地使用權交易、跨境產權交易等不斷發展，形成平等使用生產要素、公平參與市場競爭、同等受到法律保護的市場競爭機制。其次，企業成為深化粵港澳經貿合作的主體。發揮企業在經貿合作中的主體作用，促進區域內投資貿易自由化，營商環境的國際化。再次，政府為深化合作提供制度保障。政府角色轉向提供服務、維護市場正常運轉、解決市場爭端。政府按照市場的要求，提供合作所需信息、服務和制度保障，降低市場主體交易成本；逐漸形成統一的市場監管體系和社會信用體系，實現違法違規信息、征信信息的對接和共享，更多的社會力量參與市場監督；粵港澳爭端解決機制進一步完善，政府之間的對話和協商進一步加強，共同發現問題和解決問題，實現公平競爭和司法公正。

4. 合作平台不斷提升。合作示范區上升為自貿區，以點帶面、點面結合推動合作發展。粵港澳合作由最初的CEPA先行先試到粵港澳率先

實現服務貿易自由化，由前海、橫琴、南沙三大合作平台作為合作示范區升級成為廣東自貿區，體現了通過合作平台探索創新合作經驗然後推而廣之、合作平台繼續提升深化合作的發展趨勢。服務貿易自由化與自貿區形成疊加效應，進一步推動粵港澳合作新機制的探索與創新。自貿區通過不斷打破阻礙合作的體制機制桎梏，逐步實現經貿規則與國際對接，將成為粵港澳合作開拓國際市場、合作參與全球競爭、合作面對全球挑戰的重大平台；自貿區的成功經驗則不斷推廣至全廣東，形成制度擴散，自貿區繼續承擔進一步制度創新的功能，粵港澳呈現出波浪式的合作推進態勢。

二、合作的目標和前景

1. 貿易自由化。按照負面清單模式、採取“點”和“面”相結合的方式推進粵港澳服務貿易自由化進程。從“點”看，主要建設廣東自貿區。廣東自貿試驗區的範圍涵蓋了廣州南沙、深圳前海蛇口、珠海橫琴三個片區，在體制上一定要實施統一的管理體制；要明晰自己的任務，做好頂層設計，對廣東未來的經濟發展起支撐作用，同時借力廣東自貿區，構建出具有廣東特色的貿易產業鏈，推動粵港澳三地開放性貿易體系建設。從“面”上看，推進CEPA落實先行先試的措施，將“面”上的經驗推廣。逐步減少直至取消三地貿易間實質上所有歧視性措施，粵港澳服務業可根據各自專業技術和管理經驗優勢互補，合作共贏，為廣東培育現代服務業提供重要支持。通過三地服務業深度合作，廣東發展與香港國際金融中心相配套的現代服務業體系，建設與港澳地區錯位發展的國際航運、物流、貿易、會展、旅遊和創新中心。

2. 投資便利化。提高投資便利化水平，除內地鼓勵類項目和限制類項目需核准外，對港澳資本實施國民待遇和最惠待遇。“海納百川”，擴大服務業和先進製造業對港澳資本的開放領域；同時“揚帆出海”，加快構建對外投資合作政策體系，服務廣東企業聯合港澳“走出去”。探索創新投資管理模式，厘清政府與市場的關係。用“負面清單”的形式賦予三地投資便利，將資源配置的功能交由市場，給與企業充分的自由度，創造開放流動的市場氛圍。用“正面清單”的形式界定政府職能範圍，做到將“權力”關進籠子裡，發揮“正面清單”對政府的監督功能，明確政府對“正面清單”之外的投資事宜不能干涉，避免港澳資本投資內地面臨的“彈簧門”和“玻璃門”的問題。

3. 通關快捷化。進一步增加邊檢自助查驗通道，並擴大其適用範圍。將自助通關的辦理擴展至：持有有效的《往來港澳通行證》、未辦理多次簽注的居民;同時取消年齡和身高限制，進一步方便居民通關，提高通關效率。增設粵港、粵澳出入境口岸，加快實現口岸與區域一體化。加快建設粵港之間的蓮塘－香源圍口岸、西部快速通道口岸、廣深港高鐵口岸，改造粵澳之間的橫琴、灣仔等口岸，並適時延長通關時間。在三地的通關口岸全面樹立以客戶為導向的管理理念，精簡通關手續。一方面各地口岸要明確自身各部門的檢查範圍，減少重複檢查，大力推行“一站式”通關服務;另一方面三地海關、邊檢使用相同的數據交換標準和交換方式，認同彼此的監察結果，實行內地與港澳往來的一次性通關。

4. 經濟一體化。從經濟全球化和區域經濟一體化趨勢中把握粵港澳合作的方向;從全局利益和局部利益的平衡中不斷提升粵港澳合作的水平;從長遠利益和短期利益兼顧中推進粵港澳合作的進程;從政府行為和市場機制結合中構建粵港澳合作的機制。以解放思想和體制創新為動力，以服務貿易自由化和投資貿易便利化為主要內容，以創新科技產業為動力，以先進製造業的實體經濟為依托，全面推進粵港澳經濟一體化；以加強城市功能規劃為目標，以產業發展定位為抓手，融合推進城市化建設與產業發展，打造粵港澳三地城市分工體系；以嶺南粵語文化為橋梁，以經濟繁榮與社會和諧相互統一為原則，使合作成果惠及三地民生，推進粵港澳關係從經濟合作走向社會融合。

三、“十三五”時期深化合作的任務與領域

1、 加快粵港澳服務業貿易自由化。2007年3月國務院發出《關於加快發展服務業的若干意見》以來，特別是2008年12月國務院審議通過《珠江三角洲地區改革發展規劃綱要(2008~2020年)》後，構建現代產業體系就已經成為廣東特別是珠江三角洲經濟社會發展中的首要任務。2014年12月18日《內地與香港CEPA關於內地在廣東與香港基本實現服務貿易自由化的協議》及《內地與澳門CEPA關於內地在廣東與澳門基本實現服務貿易自由化的協議》分別在香港和澳門簽署，兩份協議均於2015年3月1日起實施。這意味著，廣東對香港、澳門的服務業開放領域達到了95%，且金融業屬於這次CEPA協議負面清單之列，而且最新公佈的協議細則顯示，香港證券業、銀行業及保險業進入廣東有優惠。

目前廣東省部分地區如廣州、深圳等地已經步入工業化中後期階段，但是近10年來，第三產業對珠三角地區經濟增長的貢獻一直在60%左右，遠遠低於世界大都市80%~90%的水平。另外，廣東省服務業的發展不僅表現為經濟總量中服務業的比重小，還表現為服務業的層次較低，批發零售、住宿餐飲以及交通運輸等傳統流通業比較發達，而信息傳輸、計算機服務和軟件業、金融業、科學研究、技術服務和地質勘察業等知識技術含量高的現代服務業發展相對落後。然而，香港的進出口貿易、金融及保險等現代服務業在服務業總產值中佔到了較大的比重，而澳門的金融保險、不動產、租賃和商業服務業也佔到了較高的比重，其公共行政、社會及個人服務(含博彩業)在服務業總產值的比重甚至超過了50%。

通過推進粵港澳服務貿易自由化進程可以優化廣東省的服務貿易結構，加大廣東省對外開放程度；鞏固香港作為國際金融、貿易、航運、高增值服務中心和澳門作為世界旅遊休閒中心的地位，香港的國際經濟中心和廣深的國家中心城市的作用和功能“雙劍合璧”，優勢互補，融化發展，提升珠三角在世界區域經濟發展中的地位，協力推進珠三角世界級國際都會區的建設，共同促進廣東省對外開放格局的形成。深化粵港澳現代服務業合作，應該以如下產業為重點：金融服務、商貿服務業、物流業、會展業、旅遊業、醫療服務業、教育與培訓等。

2、 打造中國(廣東)自由貿易區。前海、南沙、橫琴三大合作平台以及中山翠亨新區等具有優良的區位優勢和寬松的政策條件，發展與創新潛力巨大，加快這些新區的發展建設能在粵港澳合作當中起到良好的示范作用。廣東自貿區的三個片區既有共同的歷史使命，也有各自發展區位優勢和戰略目標。南沙新區片區將面向全球進一步擴大開放，在構建符合國際高標準的投資貿易規則體系上先行先試，重點發展生產性服務業、航運物流、特色金融以及高端製造業，建設具有世界先進水平的綜合服務樞紐，打造成國際性高端生產性服務業要素集聚高地。前海蛇口片區將依托深港深度合作，以國際化金融開放和創新為特色，重點發展科技服務、信息服務、現代金融等高端服務業，建設我國金融業對外開放試驗示范窗口、世界服務貿易重要基地和國際性樞紐港。橫琴新區片區將依托粵澳深度合作，重點發展旅遊休閒健康、文化科教和高新技術等產業，建設成為文化教育開放先導區和國際商務服務休閒旅遊基地，發揮促進澳門經濟適度多元發展新載體、新高地的作用。“十三五”時期要緊密圍繞廣東自貿區發展的戰略目標，全面推進與港澳的合作，著力推進體制和機制的創新，共同打造中國(廣東)自由貿易區。

前海需繼續探索擴大深港乃至粵港兩地跨境人民幣交易和融通，推動粵港澳資本市場的融合發展。目前，深港跨境人民幣貸款的獲得和使用條件仍十分嚴格，限制了其規模的擴大，應繼續爭取擴寬跨境人民幣貸款的資金來源和適用範圍。2014年“滬港通”啟動後，“深港通”很可能在一段時間後啟動，前海應探索建立“深港交易通”系統，通過聯網交易等方式加速兩地證券市場融合，積極開展跨境證券投資業務。

南沙土地資源豐富，應秉承著“合作開發、共同發展、利益共享”的合作思路，實現粵港澳合作開發管理機制、產業合作機制以及基礎設施共同開發機制的創新，積極開展高新科技產業、先進服務業、基礎設施等的全面合作。優先考慮港澳投資機構參與資源配置，減少投資合作的政策桎梏，積極吸引港澳企業參與南沙新區產業基地和園區連片開發。借鑒廣東產業轉移中利益共享的政策，對區內港澳企業的地方稅收，由三地按一定比例進行分成，鼓勵和吸引港澳參與南沙開發，實現港澳和南沙的共贏。

橫琴應加快通關制度的創新和完善，爭取早日正式封關運作。在橫琴的分線管理通關制度之下，到港珠澳大橋建成後，符合條件的香港車輛可通過港珠澳大橋直接進入橫琴；橫琴應積極探索創新面對港澳居民的公共服務供給模式，在橫琴居住、工作的港澳居民個人在所得稅補貼和社會保障(醫療、養老)等方面，享受與橫琴居民同等待遇，並探索與港澳社會服務的對接。充分總結澳門大學橫琴校區建設的經驗，爭取將澳門大學橫琴校區的合作模式和經驗進一步推廣，開展與澳門的全方位合作。

按照“先易後難、逐步推進”的原則，內地與香港就CEPA安排已完成了十個階段的協商，CEPA內容也在主體文件和六個附件基礎上經過了九次完善和充實。CEPA簽署十年來，服務業合作範圍不斷擴大，合作內容也不斷深化。

3、 推進珠三角世界級城市群建設。國家“十二五”規劃中在城市化戰略格局中提出，“推進環渤海、長江三角洲、珠江三角洲地區的優化開發，形成3個特大城市群”。這意味著將珠江三角洲地區列為國家層面的優化開發區域，並明確了該區域的功能定位和發展方向。隨著粵港澳合作的進一步深化，珠三角區城市群將建設成世界級、國際性的大都市圈。

首先，細劃城市群內各城市的職能分工，進一步促進珠三角的專業化，使城市間相互交錯，融為一體，形成廣泛的協作關係。香港、廣州由區域中心節點職能向更為廣泛的整合職能轉型，而相應的職能正逐步由周邊的城市承擔。大珠江三角洲城市群中的香港在金融、信息、物流等優勢和成熟的市場經濟意識，需要與內地的腹地空間相結合。從核心城市職能分工的綜合指數來看，廣州應大力提升核心城市的服務和管理水平，重點發展商業、服務、文教、交通、科技等職能，建成更具國際競爭力的商貿流通中心、科技研發中心和現代服務中心。深圳重點發展商業、金融和服務等職能，向商貿、物流、金融和信息一體化的現代化區域性中心城市邁進；珠海立足於自身基礎，憑借各大學科研機構進駐，發展為信息技術產業和現代商業及旅遊業發達的區域性中心城市。

其次，加強珠三角城市群的整合力度。珠江三角洲城市群不斷調整和優化產業結構，逐漸形成了資金、人才、管理、技術、環境等優勢，全面參與國際競爭的能力不斷增強。從歷史發展角度來看，其內部的合作已經擁有很好的根基，在原有的特殊政策優勢日漸淡化的情形下，基於經濟全球化和我國入世的新發展背景，它需要通過強化城市群內整合，實現城市群內核心城市之間的互補與錯位發展，重構區域的整體競爭力以及創造新的競爭優勢，保持經濟發展的“排頭兵”地位。

再次，積極調整政府角色。珠三角雖然同屬於廣東省，但是各個城市都各自為政，形成諸侯紛爭的局面。城市群內行政壁壘是制約城市群協同效率發揮的最大障礙。因此，政府政策的協調性和公平性顯得尤為重要。在促進珠三角城市群發展的過程中，政府應制定發展戰略目標、提供經濟立法和法律體系、完善市場體系、政策規範市場行為、協調資源配置，為整個經濟運行創造一個高效的、公平的和穩定的宏觀環境。在整個城市群內各政府間要以區域全局為出發點，統一規劃，協同發展，推進大珠三角地區邁向世界級城市群。

最後，吸收港澳城市管理服務經驗，提升城市吸引力。要成為世界級城市群，在城市建設過程中勢必要加強軟環境建設，增強城市管理服務水平，提供便利舒適的生活環境，從而提升城市國際吸引力。借鑒港澳在低碳產業發展、城市規劃建設和社會管理服務方面的先進經驗，按照綠色發展的理念，構建循環、低碳的綠色產業發展體系，為珠三角產業發展和城市建設樹立典范，建設高水平的公共服務業中心體系，增強公共中心的舒適性和吸引力，優先發展綠色、以人為本的交通體系，貫徹TOD發展理念，建立健全保護地體系，營造集約、宜居的城鄉空間，加快中心城市功能性設施建設，不斷完善城市發展佈局及擴大城市發展空間，吸引港澳地區居民在珠三角地區創業和居住，努力打造優質生活的示范區，提升珠三角城市群的國際吸引力。

4、 實現大型基礎設施對接和通關模式創新，促進通關便利化

根據《粵港澳基礎設施建設合作專項規劃》，加快粵港澳三地的基礎設施建設和對接。對於跨境大型基礎設施的建設，創新基礎設施合作模式，三地合作參與基礎設施建設與管理，爭取統一規劃、統一建設、建成後可順利實現無縫對接。由合資開發公司作為土地整備的主體以及主要基礎設施和公共設施的投資、建設、運營和維護主體，共同對三地屬於政府公共投資部分的交通、口岸等基礎設施，按照“以規劃為依據，共同投資、共同建設、共同擁有、共同管理”原則進行建設和管理，保障基礎設施的順利運行和無障礙對接。

目前在建的港珠澳大橋直接連通珠海、澳門和香港三地，全長約50公里，建成之後香港到達粵西地區的時空距離大大縮小，珠海進入香港一小時生活圈內，江門、中山、佛山南部均進入到香港90分鍾時空圈內；以珠海市為中心，包括澳門、中山、江門等市的珠三角西部都市圈格局將逐步形成，與珠江東岸城市構成循環型城市群。在做好港珠澳大橋建設的同時，廣東應提前做好港珠澳大橋相關配套工作，如口岸的通關設施、接駁交通基礎設施、口岸周邊的商業設施等。在建的廣深港高鐵全線通車後，香港可接入全國的高鐵網絡。廣東應積極與香港協商，共同探索實現“一地兩檢”的通關制度，給人們在粵港澳之間高鐵往來提供便利。廣東應根據港珠澳大橋和廣深港高鐵建成之後對經濟發展的有利影響，做好產業與城市發展的規劃工作，以適應未來的形勢需要。

在基礎設施愈發完善的情況下，創新通關模式、促進通關便利化愈顯重要。應借鑒橫琴通關管理制度，總結成功經驗，嘗試推廣到更多的地區。爭取在未來的廣東自貿區內爭取全面實現分線管理，按照“管住二線，放開一線，區內自由，接軌港澳，輻射周邊”的總體思路，設計通關監管模式。實現一線放開：海關憑艙單准予貨物先入區再申報，實現粵港澳三地監管結果互認、監管數據共享；對於境外與園區之間的進出貨物原則上不查驗，對境外入區貨物實施減免滯納金等優惠措施。強化二線管理：對園區企業進出口貨物實行預審核制度，企業自主選擇貨物申報時點；保稅延展貨物入區不退稅、出區不征稅；園區與其他海關監管區域貨物流轉不需按轉關方式處理。保障區內自由：園區內貨物自由流轉，跨不同片區之間貨物流轉，企業無需辦理申報手續；取消保稅貨物進出園內審批，運用信息化管理平台實行記賬式管理。接軌港澳，輻射周邊：園區與港澳實行數據共享，便利化港澳通關模式；接軌港澳貿易監管模式，實行區內外貨物自由流轉。在粵港澳自貿區外的區域，則應加快關口設施的升級和完善，全面推進電子通關和通關信息聯網，提高通關效率降低通關成本，促進人員貨物自由來往。

5、 建設粵港澳大灣區，打造“一帶一路”橋頭堡和發動機

“充分發揮深圳前海、廣州南沙、珠海橫琴、福建平潭等開放合作區作用，深化與港澳台合作，打造粵港澳大灣區”是國家“一帶一路”建設的重要內容。深化香港、澳門和廣東之間的

合作，整合三地的優勢，可以為“一帶一路”建設提供重要支撐和動力。

第一、促進粵港澳經濟深度融合，為“一帶一路”建設提供動力。以廣東自貿區建設為依托，推進粵港澳經濟深度融合，打造粵港澳大灣區，為“一帶一路”建設提供強大動力。廣東自貿區建設將會引領內地的新一輪改革開放，加快廣東產業轉型升級，促進港澳經濟發展，推動粵港澳經濟深度融合，打造粵港澳大灣區，促進“一帶一路”特別是海上絲綢之路建設。充分發揮橫琴、前海和南沙自貿區發展帶來的制度創新優勢和毗鄰港澳的區位優勢，落實國務院批覆的自貿試驗區建設總體方案，深入推進粵港澳服務貿易自由化，深化粵港澳金融合作，強化粵港澳國際貿易航運功能集成，提升粵港澳區域經濟的國際競爭力，為“一帶一路”建設提供動力。

第二、推進國際產能合作，為“一帶一路”提供產業支撐。國家提出將我國產業優勢和資金優勢與國外需求相結合，以企業為主體，以市場為導向，大力推進國際產能和裝備製造合作，促進國內經濟發展、產業轉型升級，拓展產業發展新空間，打造經濟增長新動力。力爭到2020年，與重點國家產能合作機制基本建立，一批重點產能合作項目取得明顯進展，形成若干境外產能合作示范基地。廣東特別是珠三角地區製造業發達，其中輕紡、家電、建材、信息、通訊等行業是我國的優勢產業，被稱為世界製造業基地。香港的金融、商貿服務業和現代專業服務人才，澳門是葡語國家商貿服務平台。粵港澳三地可以充分發揮自身優勢，抓住國家“一帶一路”建設和推進國際產能合作的機遇，將二者有機結合起來，推動本區域特別是珠三角製造業“走出去”，在“一帶一路”國家建設產能合作園區。

第三、深化區域金融合作推動人民幣國際化進程。2015年第17期“全球金融中心指數”(GFCI)發佈，這份每半年更新一次的全球金融中心競爭力排行榜顯示，全球排名前十的國際金融中心中，紐約和倫敦繼續領跑，並拉大了與後來者的差距；香港、新加坡和東京仍然在亞洲領先，依次排名全球第三至第五。中國內地則有上海、深圳、北京和大連四個城市上榜，12個入榜亞洲金融中心的城市中，有11個得分和排名上升，上海得分695，排名全球第16，較上期上升4位；深圳得分689，名列全球第22，上升3位；北京得分674，名列全球第29，上升3位。大連首度進入榜單，成為我國內地第四個進入GFCI指數的金融中心，排名全球第51。粵港澳金融合作潛力巨大，將能對內輻射中國內地，對外輻射全球市場，為“一帶一路”建設提供強大的金融支持，推動人民幣國際化進程。

(1) 引進香港金融機構和管理，打造南方金融總部基地和國家金融創新示范區。利用前海、南沙和橫琴自貿區建設的制度創新優勢和毗鄰港澳的區位優勢，引進香港金融機構以及相配套專業服務，加快金融管理體制創新，推進利率體系和形成機制的改革。通過和香港銀行業合作吸引人才、借鑒管理經驗、開拓金融服務產品，打造地區銀團貸款和財富管理中心。其一，借鑒國際銀行業成功經驗，在珠三角地區率先建立客戶信息的保密制度，建立個人及團體資產專業化管理體系，吸引香港優秀銀行業人才進入，在廣東建立起特有的專業化銀行服務。其二，應允許設立港澳資銀行以及民資與港澳資合辦合資銀行。港澳資銀行可在前海、南沙和橫琴自貿區開展擴大人民幣業務試點，享受國民待遇，可從事各類零售及批發銀行業務，包括接受存款、企業融資、貿易融資、財務活動、貴金屬買賣及證券交易等。其三，借助與香港的同業合作，著重建設以銀行業為重心的金融業，大力發展銀行存貸款業務，打造華南地區銀行業務中心。其四，結合廣州及深圳正在形成的對資本市場的巨大需求，推動粵港澳金融機構攜手開發銀團貸款，引進金融產品，開展網絡銀行合作，推動華南地區銀行機構在香港發行人民幣債券。支持香港銀行機構入股本地銀

行機構，以最大限度地發揮協同效應。其五，加快推進以中央銀行利率為基礎，以貨幣市場利率為中介，由市場供求決定金融機構存貸款利率水平的市場利率體系和形成機制的改革步伐。

(2) 推進人民幣及外匯跨境結算合作，提升區域性資金結算中心地位。廣東要加強與香港的結算合作。其一，完善人民幣和外匯跨境結算系統，積極推動跨境外匯結算系統和境內外匯結算系統的聯網，提升區域性結算中心地位。其二，支持深圳銀行機構為符合條件的香港銀行機構開立人民幣同業往來賬戶、為符合條件的香港企業開立非居民人民幣結算賬戶，推動深港跨境個人人民幣業務穩步開展。其三，加強與香港金融管理局和金融機構的溝通，推進廣東自貿區跨境人民幣貸款業務的開展，爭取擴大試點範圍。利用新框架下市場准入放寬，建立人民幣離岸業務中心的人民幣回流機制。

(3) 打造人民幣國際化的境內橋頭堡，支持香港人民幣離岸業務中心發展。充分利用前海作為內地金融創新示范區的制度創新優勢和毗鄰香港的區位優勢，在人民幣國際化過程中發揮積極作用。推進前海區域開展境內人民幣"走出去"和境外人民幣"流進來"兩個方向的跨境人民幣業務創新。在前海區域內對境外資本逐步地開放國內金融市場，可以考慮在中國尚未放開資本項目、人民幣尚不能自由兑換的總體宏觀背景下，通過中央政府和人民銀行的政策和制度創新安排，在前海積極試行人民幣有限度的自由兑換，探索人民幣國際化和資本項目的開放路徑及其風險防范措施，為人民幣國際化積累經驗、探索路徑，支持香港人民幣離岸業務中心的建設和發展。

(4) 適時推出"深港通"，推動深港兩地資本市場融合發展。

國務院總理李克強2015年1月5日在深圳考察時表示，滬港通後應該有深港通。希望能在2015年推出的深港通，促進資本市場的融合，加快A股市場國際化進程。從區位優勢看，深圳與香港地理相連，交通便利，兩地包括資金流、信息流、投資理念等都有非常緊密的聯繫，深港通推出後對兩地資本市場的發展會有積極的促進作用，有利於探討在金融、法律等眾多方面進行全面融合，通過實踐制定有利於兩地資本市場共同發展的游戲規則。

四、政策建議

1、 著眼整體和長遠，構建深化區域合作的利益共同體

粵港澳均需要通過合作提高競爭力，拓寬國際市場。隨著經濟實力的不斷提高以及服務業尤其是現代服務業的快速發展，廣東與港澳過去"前店後廠"的經濟互補關係逐漸減弱，服務業的競爭態勢愈發明顯。然而，若縱觀全局、放眼長遠則可發現，無論是廣東還是港澳，最終目標都應該是提升自身的國際競爭力，積極開拓國內國際兩個市場尤其是國際市場，此兩者符合粵港澳之間的共同利益和長遠利益。從長遠來看，單靠內地市場來"養活"港澳顯然是不夠的，而廣東也不能單單依賴港澳來發展自身，因此雙方都需要尋求開拓更廣闊的國際市場，參與國際競爭，在國內國外市場上都保持較高水準。

粵港澳之間應通過對話協商達成共識，明確三方的共同利益，關注長遠利益。須知，要實現提升國際競爭力、開拓國內外市場這兩個目標，粵港澳的潛在競爭對手在粵港澳之外，靠粵港澳各自的單打獨斗恐力不從心，只有齊心協力、優勢互補方能在激烈的國際競爭中脫穎而出。在經貿合作空前緊密的今天，粵港澳實乃利益共同體，可謂一榮俱榮、一損俱損。因此，從全局來看、從長遠來看，粵港澳之間仍是合作大於競爭的關係；即使競爭也應是良性競爭，不應通過削弱一方的競爭力來促進另

一方的發展。“十三五”期間，粵港澳仍應加強各方的對話、交流與全方位的合作，在各方利益之間、在短期利益和長期利益之間尋找平衡點，促進共同發展。

2、 加強市場的作用，促進政府職能轉變

在粵港澳合作中三地政府扮演的角色存在差異。在過去的粵港澳合作中，政府起到了舉足輕重的作用，也起到了一定的效果；但在很多情況下，市場的反應並不熱烈，合作常常出現“雷聲大，雨點小”的現象。其中一個重要原因，便是內地和港澳政府在經濟發展中的扮演著不同的角色，內地的“大政府、有限的開放市場”與香港的“小政府、大市場”營商文化有著本質的差別，內地的商業文化傾向於以國家意志打造產業體系，而香港則更多的是企業和個人以經濟效益建立產業體系。

粵港澳合作應強化市場功能。事實上，根據不同行業的特點，上述兩種做法各有優劣；但對於大多數行業而言，減少政府的干預、強調市場的作用更為有利，同時也是國際發展的趨勢。十八屆三中全會指出：“積極穩妥從廣度和深度上推進市場化改革，大幅度減少政府對資源的直接配置，推動資源配置依據市場規則、市場價格、市場競爭實現效益最大化和效率最優化。政府的職責和作用主要是保持宏觀經濟穩定，加強和優化公共服務，保障公平競爭，加強市場監管，維護市場秩序，推動可持續發展，促進共同富裕，彌補市場失靈。”因此，為減少粵港澳市場管理的差異，主要應是廣東依據中央精神、根據與國際接軌和與港澳接軌的需要，切實實現政府職能轉變，在粵港澳合作當中更多的發揮市場的作用。

明確政府職責，著實實現政府職能轉變。在粵港澳合作當中，政府的主要職責應是維護和完善市場規則，為產業發展提供指引，為企業提供服務，創造合作條件，解決合作中的問題和爭端，以及支持和鼓勵創新、研究和開發活動；至於資源配置以及企業之間是否合作、如何合作、在哪些方面合作等盡可能交由市場來決定。具體而言，廣東應建立公平開放透明的市場規則，實行統一的市場准入制度，在已有負面清單基礎上，港澳企業可依法進入已開放領域，並與內地企業開展公平競爭；清理和廢除妨礙公平競爭的各種規定和做法，嚴禁和懲處各類違法實行優惠政策行為，反對地方保護，反對壟斷和不正當競爭。合理制定發展規劃，在落實規劃過程中亦應審時度勢，根據經濟發展的需要靈活執行。開展各類合作促進會，給企業之間的交流與合作創造條件，為粵港澳企業的合作提供必要的信息和服務，並建立爭端解決機制，降低企業合作與交易成本。對於創新性活動可通過稅收優惠、補貼等形式給予大力支持，鼓勵粵港澳在創新領域的合作，同時健全技術創新市場導向機制，發揮市場對技術研發方向、路線選擇、要素價格、各類創新要素配置的導向作用。

3、 拓展合作領域，促進粵港澳社會經濟融合

借鑒和引入港澳的優秀制度和經驗，加強與港澳同行合作，提升社會管理和服務水平。在粵港澳示范區內進行粵港澳社保服務對接的充分試驗，支持區內企業與聘用的港澳人員簽訂勞動合同並按照規定繳納社會保險費，實現港澳與區內社保服務對接，並盡快推廣到全省。探索新型醫療保障制度，允許廣東醫療機構試行對接港澳醫療保險，率先探索完善粵港澳居民轉診制度，推進三地互認檢驗檢查結果，使港澳居民享受更加便利的轉診等醫療服務。為港澳社會服務提供者提供便利。鼓勵、引導港澳服務提供者舉辦養老機構和從事居家養老服務，並允許港澳註冊社會工作者在當地執業，合作開展社會工作服務、督導及人才培養，促進粵港澳養老服務合作發展。

加快在廣東省範圍內放寬專業服務人士准入條件，為專業服務人士提供便捷通道和服務，為港澳專業人士在廣東工作創造有利條件。參照國際標準建立職業資格互認機制，率先實施內地、港澳與國際職業資格“一試三證”的模式，

實現三地職業資格互認。粵港澳三地應在互利共贏的前提下，相互開放更多專業領域。進一步擴大港澳人士參加廣東專業資格考試的範圍，逐漸將範圍擴大至所有的專業服務業，並盡可能在港澳設立各專業資格考試考場。盡快實現更多專業資格的互認，尤其是對差異較小的建築設計及其他技術專業，包括屋宇裝備工程師、電機工程師、園境師、土木工程師等加快互認。盡快解決已取得內地專業資格的人士在廣東的執業資格問題，優先處理廣東監理工程師已獲資格互認的會員加快獲得職業印章，並盡量以技術水平考核港澳工程師。

深入探索行政管理與公共服務相分離，同時把事務性和輔助性工作交由社會組織承擔，借鑒並進一步完善前海新區採用法定機構進行管理的經驗，成立行政化管理與企業化運作相結合的公共管理機構；創新社會治理結構，借鑒港澳社會管理經驗，轉變政府職能，強化公共服務，提升服務效率。探索建立以人為本、協商民主、多元參與的治理機制，形成公開透明、辦事高效的社會管理體制。探索建立各級政府職能分層、社會自治體系。理順管理體制機制，優化人力資源配置、提高服務管理效能。廣泛動員和組織群眾依法有序參與社會管理，培養公民意識，強化社會自治精神，健全基層人民調解機制，實現自我管理、自我服務、自我發展。努力形成支撐粵港澳更緊密合作的良好社會環境，不斷拓展與港澳社會管理合作的領域，積極引入港澳社會管理機構和人才，打造與港澳建設標準接軌、社會保障服務銜接的優質國際化社區，打造粵港澳優質生活圈。

4、 完善中央主導與協調，粵港澳平等參與的合作機制

由於港澳有著與內地不同的政治、經濟和法律制度，並且屬於同一個國家內的不同關稅區，因此粵港澳三地都具有一定的相對獨立性，從而使區域的總體利益並不能代表個體的利益，即總體利益實現了最大化，但是個體的利益可能得不到實現；因此，須以中央政府為主導，建立區域利益協調機制，方能有效解決地區間的利益沖突，實現各地區的優勢互補和共同發展。在實現路徑上，粵港澳區域經濟一體化行為不只是地方政府間的協調行為，而應該更進一步由中央政府主導建立法律框架下的契約行為。這種法律框架下的契約行為，需要採取政府主導、企業跟進和協會生成的多頭並進方式，逐步完成。粵港澳之間的具體協調機制應體現為各自中長期經濟發展規劃、大型基礎設施建設和對接、區域產業轉移和產業升級、政府間產業政策等方面。另外，粵港澳之間地區經濟政策和相關措施要盡可能公開，這樣可使任何一個地區增加經濟合作中的可預測性，最大限度地減少由於信息封鎖而導致的合作風險。中央政府應擔當起制定粵港澳績效激勵機制的主體功能，要用國家戰略、具體政策對粵港澳區域經濟一體化進程給予鼓勵和支持。

在此基礎上，由中央政府牽頭，創新粵港澳合作組織模式，實現包容性發展。包容性發展背景下粵港澳合作的參與主體應由目前的企業主導與政府、社會輔助，演變為政府主導、市場與社會協同參與的格局。具體而言，粵港澳合作的組織機制安排均由這麼幾個部分組成：

高層會晤機制。粵港澳三地政府高層應適時舉行會晤，研究重大合作事項，共同探討粵港澳發展的定向，坦誠交流各自利益訴求，達成戰略性共識，分析並探求各方均能接受的發展思路形成合作綱領性文件，並爭取得到中央政府的支持。

合作辦公室制度。完善粵港澳合作工作制度，爭取建立粵港澳三地合作辦公室，合作辦公室負責制定粵港澳區域一體化的相應政策，從粵港澳的合作大局出發，提升政府間交流合作層次，並且在三地都設有辦事處，對當地政府相應部門具有一定的約束力。

工作小組制度。立合作創新的長效機制，可以由中央政府牽頭，粵港澳三地借鑒APEC的專業工作組的運行機制，成立貿易工作組，金融工

作組，投資工作組，能源工作組，交通運輸工作組，旅遊會展工作組，教育科技工作組等，根據合作的實際情況，建立相應的工作組，建立各個專業部門的銜接落實制度，制定相應的合作原則，合作目標，合作內容和合作機制，使各個部門能夠更好的協調與溝通。

諮詢機制。吸納內地及港澳各界代表和專家智庫參與粵港澳三地合作政策的制定的實施，形成政府、業界和研究機構互動機制，研究探討各領域合作發展策略、方式及問題，舉辦合作發展論壇，向粵港澳高層提供政策建議。

民間合作機制。支持粵港澳工商其企業建立聯繫機制，設立行業協會合作平台，促進建立統一服務市場；支持雙方工商企業界、專業服務界、學術界等社會各界加強交流與合作；支持雙方工商企業界、專業服務界、學術界等社會各界加強交流與合作；支持雙方行業協會開展人員培訓、資格互認、行業自律等工作，共同制定區域行業規則。

作者簡介

陳廣漢，經濟學博士。中山大學粵港澳發展研究院副院長，首席專家。港澳珠三角研究中心主任，教授。全國港澳研究會副會長，中華發展經濟學研究會副會長，國務院發展研究中心港澳研究所高級研究員等。

澳門城市可持續發展研究

王志石
澳門科技大學環境研究院

澳門可持續發展面臨著三個挑戰，即城市環境污染的壓力始終存在，如何評價這些不同環境介質中的污染，找到控制污染的途徑是實現可持續發展的第一項挑戰；其次，如何實現城市廢棄物的循環再利用是一項新的挑戰，首先需要在城市管理理念上創新；第三項挑戰是是實現可持續發展的各項政策的理論基礎研究，這是自然科學與社會科學的跨學科研究。

對於第一項挑戰，我們系統評價了澳門市區空氣污染，包括現場調研，儀器分析和電腦類比。通過澳門城區空氣中的顆粒物化學成分的分析，特別是正烷烴碳數GC圖譜分析確定了澳門空氣中顆粒物污染主要來自於化石燃料燃燒，具體的說就是機動車尾氣污染。而通過電子顯維鏡分析(electronic microscopic analysis)，發現澳門空氣中顆粒物的組成和形貌也可以得出相同的結論，即市區機動車尾氣污染。然後通過生物電泳DNA氧化損傷分析，得出這種顆粒物(PM10)存在著對人體(遊客)的肺部組織DNA損傷風險。

針對澳門周圍水域的POP分析和調研，發現持續有機污染物POPs也是與水中的顆粒物相關聯，即發現多環芳烴和聚合有機鹵化物富集在河口底質顆粒物(sediment)之中，造成了對水生生態環境以及人體健康的潛在風險。

總之，對於全球關注的持續有機污染，即POPs 污染，我們針對澳門的具體情況作了一些初步工作，願意跟大家分享，交流。

而關於城市可持續發展戰略的相關的基礎理論研究，我們主要是作了如下研究工作1)利用計量經濟學方法研究了非市場貨品(如黑面琵鷺)和服務(如城市垃圾回收服務)的資產定價；2)研究了澳門城市生態足跡的供給和需求的平衡度量；以及3)澳門城市社會經濟運轉的能值分析。

本次交流將集中談四個方面的具體研究成果：1)澳門城市空氣環境影響評價，2)澳門周邊地區對澳門城市空氣品質影響CFD評價，3) 澳門荷蘭園社區WRF—LES耦合模型計算其空氣污染物濃度分佈結果，和4)澳門特區生態足跡的供給和消費帳戶平衡研究。

I. 澳門城市空氣環境影響評價

針對澳門特區可持續發展的需要，對澳門城市環境進行了系統地環境影響評價研究。 包括，對規劃的和建設中的專案實施後可能造成的環境影響進行分析、預測和評估；提出預防或者減輕不良環境影響的對策和措施；進行跟蹤監測的方法與制度。1969年，美國首先提出環境影響評價的概念，並在《國家環境政策法》中定為制度。隨後，日本、歐洲也陸續推行。中國1979年頒佈的《中華人民共和國環境保護法(試行)》規定，在進行新建、改建和擴建工程時，必須提出對環境影響的報告書。環境監測只能說明現在，對未來可能的環境影響程度只能靠電腦的模型預測；為了提出預防和減輕環境影響的工程方案，其電腦模型必須能夠解釋相關的物理化學過程。

首先對澳門城市空氣品質及污染影響進行了系統評價。自1996年至今，從多角度綜合地持續地研究，包括風洞試驗以確認澳門街道內尾氣擴散的空氣動力學特點 – 城市街區峽穀效應 (低風速高湍流度)，利用現場監測和實驗室化學分析追蹤澳門空氣中持續有機污染物(POPs)的來源 – 尾氣排放，流體動力學計算 – 集中描述街區內的空氣流動場及污染物濃度分佈,空間污染評價系統 – 地理資訊系統的應用。

對澳門城市空氣中的氣溶膠顆粒進行碳數分析(見圖1)，發現澳門城市空氣中的顆粒物主要來源於化石燃料的燃燒。

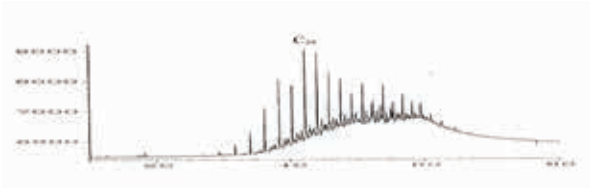


圖1 澳門空氣顆粒物的色譜- 質譜分析

圖2 給出了澳門城市空氣中顆粒物(PM10)以及氣體污染物CO 等與機動車流量的正相關性。而圖3 則介紹了針對澳門街區的空氣動力學特徵所進行的風洞實驗。從圖2 的研究結果可見，澳門城市空氣污染主要是由於機動車尾氣排放造成的。

除了機動車污染源決定了城市空氣品質之外，澳門特殊的城市街道佈局也起了很大作用。圖3 所示的風洞實驗結果鮮明的表現出一種典型的街區峽穀效應，即街區內風速很小，而湍流度卻很大。這一特點不利於機動車尾氣擴散。

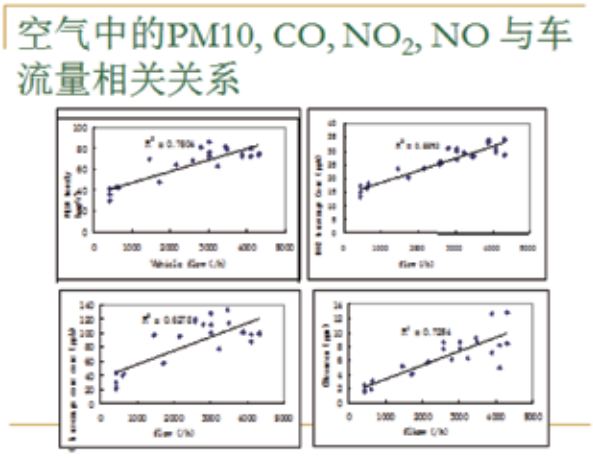


圖2 澳門城市空氣中PM10 CO NO 等氣體污染無與機動車流量的正相關性

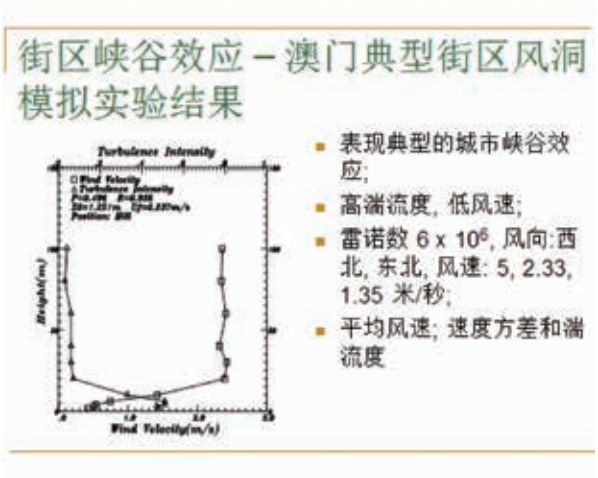


圖3 澳門城市峽谷效應的風洞實驗結果

電腦模型對城市機動車尾氣污染進行評價是國際慣例，目前常用的評價空氣中污染物濃度分佈的電腦模式有，CAL3QUHC和 CALINE4（以高斯靜態煙雲模式為基礎），OSPM（直接擴散濃度Cd和街區內氣流蝸旋造成的污染物迴圈而形成的濃度Cr之和），即Cst = Cd + Cr ，ISCST3（高斯靜態煙雲模式加上城市地理資訊系統）。而評價機動車尾氣排放源的電腦模型是Mobile5，它是根據機動車的車型（輕型，重型車輛，私家車，柴油車等）以及機動車工況（怠速行駛，暖開機等）來計算每公里尾氣排放的量（或濃度）。

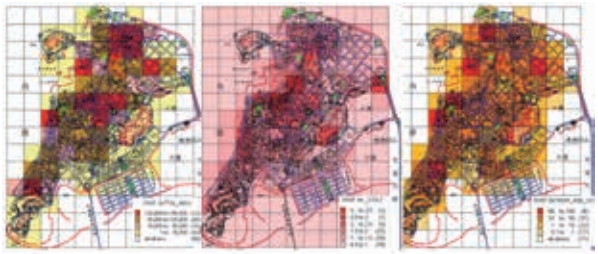


圖4 澳門半島人口分佈，氮氧化物排放分佈以及人員曝露時間的模型計算結果

II. 澳門周邊地區對澳門城市空氣品質影響的 CFD 研究

為定性考察周邊城市（香港、廣州、深圳、珠海）污染源對澳門空氣品質影響的主要因素，本項研究首先設計了模型污染源（如圖5所示）擴散的算例，即，將污染源置於城市40-80米的

高空(厚度40米)，源強為100mgm-2s-1，選用不同類型的污染物且互不反應，其中，紅色為香港地區一氧化碳等厚度面源(高度40-80米，厚度40米)(圖中：藍色為深圳的甲苯污染源；綠色為廣州的乙烷源；黑色為澳門源；褐色為珠海的丙酮污染源(在nest5中計算污染物)，各污染物間無化學反應。

圖 5 澳門周邊城市模型污染源示意圖

採用WRF五重嵌套方法(圖6所示)類比周邊城市模型污染源(廣州，珠海，深圳，香港)的擴散過程，考察這些城市模型污染源對澳門的影響。

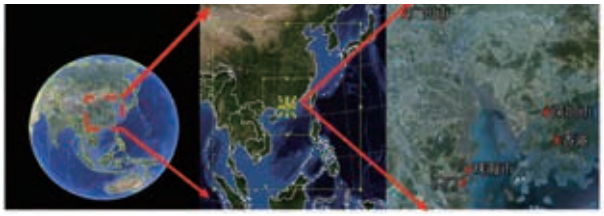
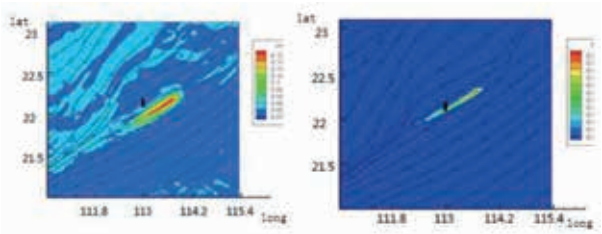
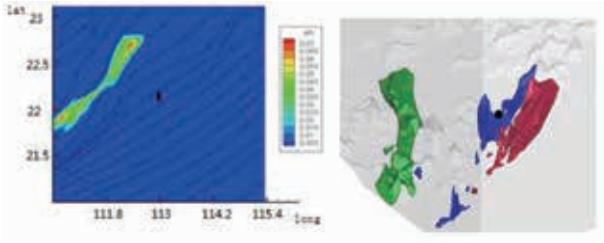


圖 6 耦合求解過程示意圖

本算例計算24小時以後，所得風場、溫度場和各污染物的濃度場示於圖7，圖中顏色表示第4層嵌套求解域內不同污染物的濃度：

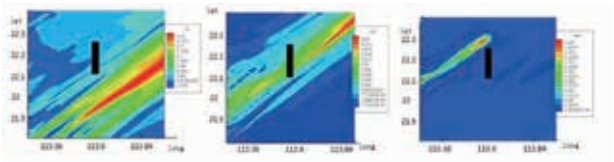


香港污染源的擴散　深圳污染源的擴散



廣州污染源的擴散範圍　　立體圖
(第4層嵌套求解域內，座標為經緯度，圖中黑色方塊為澳門地區)
圖7 不同污染源24小時擴散的範圍

圖 8 是 第5層嵌套求解域內污染物的濃度分佈，從圖7可看出，在本算例中，由於東北風向，廣州污染源影響不到澳門(略)。珠海離澳門最近，由於東北風向，珠海污染源基本沒有進入澳門(圖8)，可看出，此風向作用下影響最大的是來自深圳的污染源。

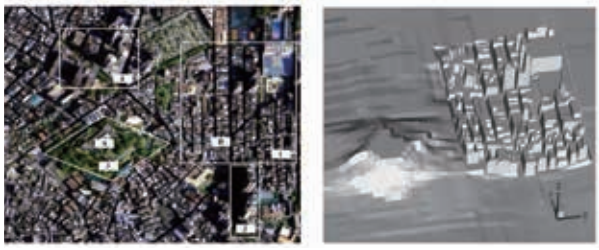


香港污染源濃度分佈　深圳污染源濃度分佈　珠海污染源濃度分佈
(第5層嵌套求解域內，座標為經緯度，圖中黑色方塊為澳門地區)
圖8 不同污染源24小時擴散的範圍

由以上結果可看出：周邊地區污染源對澳門的影響與當天風向密切相關，因此，全面考察周邊地區污染的影響，需要計算更多典型算例，包括一年四季盛行風向。

III. 澳門荷蘭園社區 WRF-LES 耦合模型算例及結果

本節應用WRF-LES算例的耦合模型以及前期專案提出的下墊面組合模型，不計當地污染，精細計算了澳門周邊污染源擴散到澳門荷蘭園社區的濃度分佈，並與WRF模擬結果(不耦合精細LES)進行比較，優化研究方案。



(a)荷蘭園社區及周邊地區的航拍圖　(b)組合模型的效果圖

圖9 澳門荷蘭園社區數值模擬計算域

圖9顯是澳門荷蘭園社區耦合算例的計算域。圖9（a）的白色方框B內為精細分辨區域，採用浸沒邊界法滿足地表無滑移條件，周邊區域應用阻力元方法類比地面建築對大氣運動的阻力特性。

圖10 為WRF-LES耦合算例2012年1月9日距地面2m高度處的CO濃度場，可見在荷蘭園社區，外來CO濃度分佈水準分佈較為均勻，約在0.09至0.11毫克/立方米之間。圖12為監測點（圖11中A點）處CO濃度的日變化，分別給出了WRF與WRF_LES耦合的計算結果。可見耦合計算結果與WRF結果符合較好，僅在CO濃度變化劇烈時，兩者有較大差距。

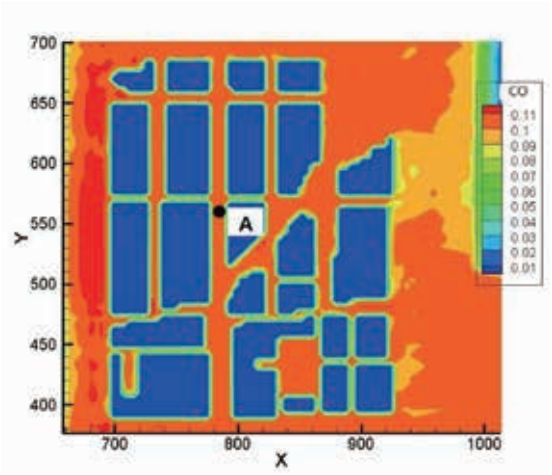


圖10 荷蘭園CO濃度水準(1月9日15:00)

IV. 澳門可持續發展的評價 — 生態足跡帳戶平衡

任何已知人口（某個個人、一個城市或一個國家）的生態足跡是: 1)生產這些人口所消費的所有資源，2)吸納這些人口所產生的所有廢棄物。所需要的生物生產土地的總面積和水資源量。人均生態足跡為2.8 ha，而人均生態承載力為2.1 ha，人均生態赤字為0.7 ha。所計算的52個國家和地區中的35個國家和地區存在生態赤字。全球範圍，人類的生態足跡已超過了全球生態承載力的30%。人類現今的消費已超出了自然的再生產能力，即在耗盡全球的自然資產存量。

根據生物物理的基本原理，針對澳門城市發展的歷史和現狀，可以整理出澳門生態足跡的基本情況，部分帳戶可見表1和表2。生物質資源主要是指每日供應的和消費的食物。表1的計算結果表明澳門人主要以海鮮如魚類作為主要的營養來源。其人均生態足跡與香港相仿佛。

表1 澳門生態足跡的基本帳戶(生物質資源部分)

分類專案	全球均產量 [kg/ hm2]	生產量[t]	進口量[t]	出口量[t]	消耗量[t]	人均足跡 [hm2/cap]	足跡類型
食物類			195,330	11,157	184,173		
肉類(以草為食料生產的動物產品)	74		43,474	274	43,200		
牛肉，羊肉	33		2,449	7	2,442	0.1509	草地
非牛肉，非羊肉	457		41,025	267	40,758	0.1808	耕地
奶脂類			10,821	7,000	3,821	0.0154	草地
奶	502		3,501	30	3,471		
芝士	50		241		241		
動物油	50		491	697	-206		
魚類	29	1,624	11,811	696	45	1.5553	海域

表2 澳門生態足跡的基本帳戶(能源部份)

燃料種類	全球平均足跡 GJ/hm2.a	折算系數GJ/t	消費量 t	年人均消費熱量 GJ/a.cap	人均足跡 hm2/cap
煤炭	55	20.934	56.825	0.0024129	4.387E-05
焦碳	55	28.47	4449.913	0.2569757	0.0046723
石油氣	71	50.2	25399.883	2.5863573	0.0364276
汽油	93	43.124	34956.019	3.0576944	0.0328784
煤油	93	43.124	608542.952	53.230844	0.5723747
柴油	93	42.705	106438.909	9.2200276	0.0991401
重油	93	41.868	350664.802	29.780191	0.3202171
燃料油	71	50.2	4527.916	0.4610576	0.0064938
總計					1.0722478

據此，可以得出如下結論：1)澳門對自然的影響遠遠超出了其生態承載能力的範圍。2)能源用地占整個足跡的43.3%，導致澳門生態赤字較大。3)進出口貿易量大，因此，可認為澳門的發展模式取決於對進口大量消費品的支付能力。4)弱可持續的狀態，即經濟的可持續依賴於外部的可持續發展的條件。

生態足跡是人們所消耗的每種消費品的生物生產面積的總和。有效生態承栽力是自然介能夠對人類提供的生態服務。從生態足跡的供給和消費需求的帳戶平衡中可以計算出生態赤字，從而分析判斷發展的可持續性或不能持續發展的危險性。世界上部分國家的人均生態赤字資料(單位：公頃／人)已經表明這個發展危機已經到來。下面列舉一些國家或地區的生態足跡赤字，新加坡-6.8，比利時-3.8，美國-3.6，英國-3.5，日本-3.4。當生態赤字為負值時，從全球的角度看是盜用了下一代的資源。而澳門的生態足跡也出現了赤字，也處在弱可持續發展狀態。

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省港澳之於"一帶一路"

趙雅各工程師,OBE, JP
保華建業集團有限公司主席
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中國環境保護集團有限公司總工程師(香港)

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- 一帶一路 (OBOR)地緣政治
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- 省港澳品牌
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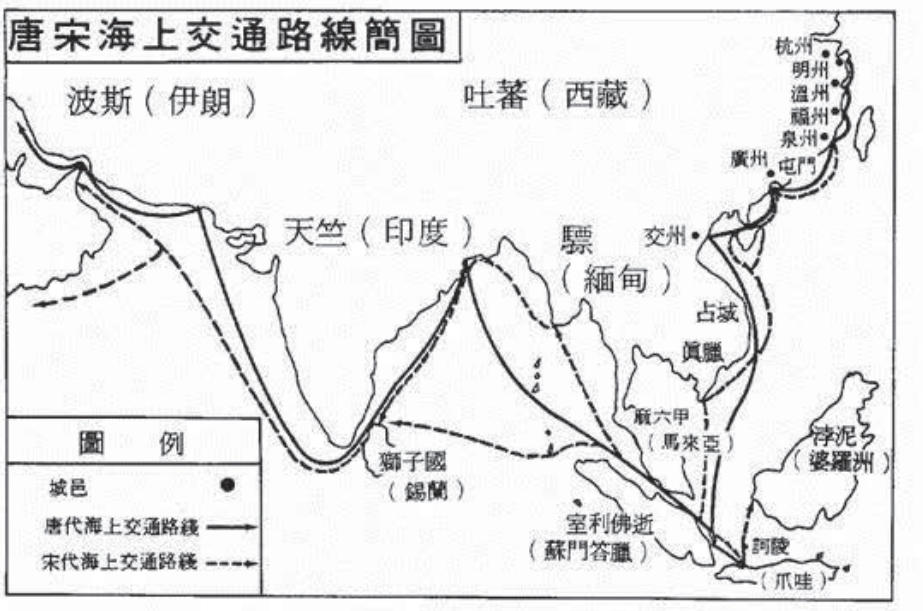
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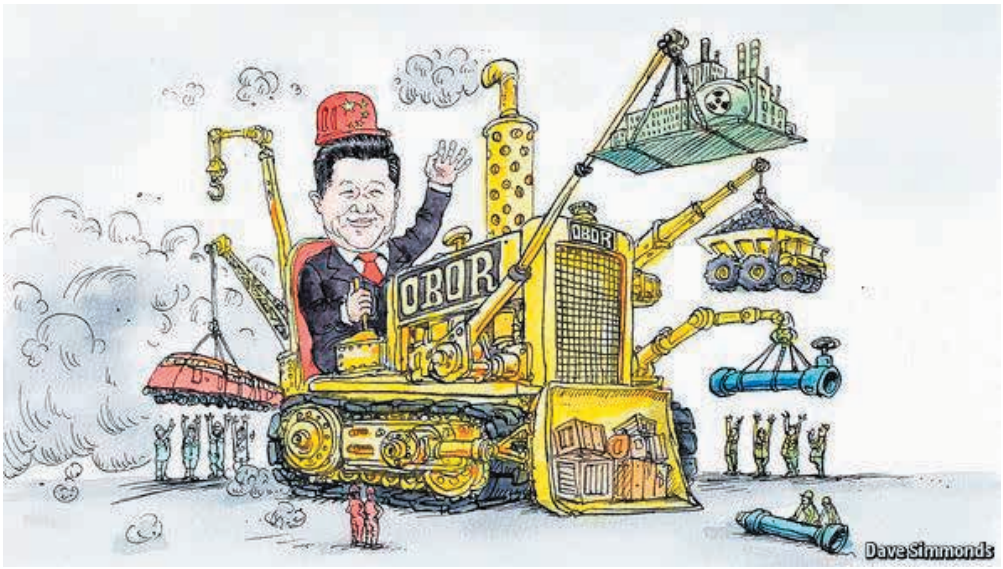

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美利堅的回到亞太
美日的　世界銀行　亞洲發展銀行
亞洲基健投資銀行
ASIA INFRA STRUCTURE INVESTMENT BANK
(AIIB)
香港尚未被容許加入為會員

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中國可否持續財政承受

報稱中國2015/16 11月內
外匯流失 USD500B 5仟億
此數少於中國1%儲備
少於中國於AIIB承擔
70% AIIB USD100B 資本
由其他56會員承擔
杞人憂天

AIIB 發展項目

絲路國家基礎建設
首個單獨由中國承擔
BANGLADESH 供電於250萬家庭項目
其他項目

AIIB 發展項目

項目表

OBOR galore

Selected One Belt, One Road projects signed, being discussed or under construction

Middle East Asia Africa Rest of world

Country	Project	Value, $bn
Russia	Power of Siberia gas project	55.0
Qatar	Lusail city	45.0
Azerbaijan, Georgia, Turkey	Shah Deniz II gas field	28.0
Indonesia	Trans-Sumatra toll road	27.7
Romania	Cernavoda nuclear power plant units 3 and 4	7.8
Rwanda, Burundi, Tanzania	Dar es Salaam-Rwanda-Burundi railway	7.6
Saudi Arabia	Saudi land bridge	7.0
Mongolia	Oyu Tolgoi mine	4.4
Pakistan	Peshawar-Lahore-Karachi railway	3.7
Kazakhstan	Almaty ring road	0.68

Source: Economist Intelligence Unit

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省港澳之結合

超過1500年的自然結合

自由出入

自由貿易

無關稅

- 白話
- 粵曲粵劇
- 嶺南派文化
- DNA

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省港澳結合或獨行

強弱分析

SWOT

京城中央政府另眼相看

方言統一

嶺南文化

對AIIB 影響力

統籌採購國內外工廠, 工場材料器械供應

超級承包商吸引力

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省港澳獨行俠

全部 X 1/3 甚至0.1

THREATS 危機

- 省港澳各自為政
- 合作計劃不周全
- 不善利用省港澳結合強項及歷史背景

OBOR 與可持續現代城市

可持續的基礎建設

空氣 電力 食水
路 橋 隧道
交通系統
垃圾 污水處理

焚化爐

- 垃圾倉
  低部5-6米深
  40% 垃圾水份滲濾液
- 燃燒爐和高熱廢排氣
  850℃-1001℃
- 蒸氣爐與廢排氣
- 高溫蒸氣450℃推動發電機
  發電30MW每1000噸垃圾　廠用和電網
- 廢水及排氣處理
  垃圾水滲濾液和灰燼處理

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一帶一路基建項目

投資財務

- PPP　BOT
- 出口信貸擔保
  出口保險
- 政治科技風險
  英國 HINKLEY 核電廠
  科技風險　再生能源
  Gas turbine battery

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OBOR 項目投資

政治風險 Political Risks

政策穩定
外國惡意干預
政權管治穩定
地緣政治因素
反華勢力活躍與否

工業新動向－工業可持續性

鄭文聰教授工程師
香港工業總會主席
（香港）

INDUSTRY +

THE MOVEMENT AND SUSTAINABILITY IN INDUSTRY

SEPT 23, 2016

Prof. Daniel M. Cheng
Chairman, Federation of Hong Kong Industries
Managing Director, Dunwell Enviro-Tech (Holdings) Ltd.

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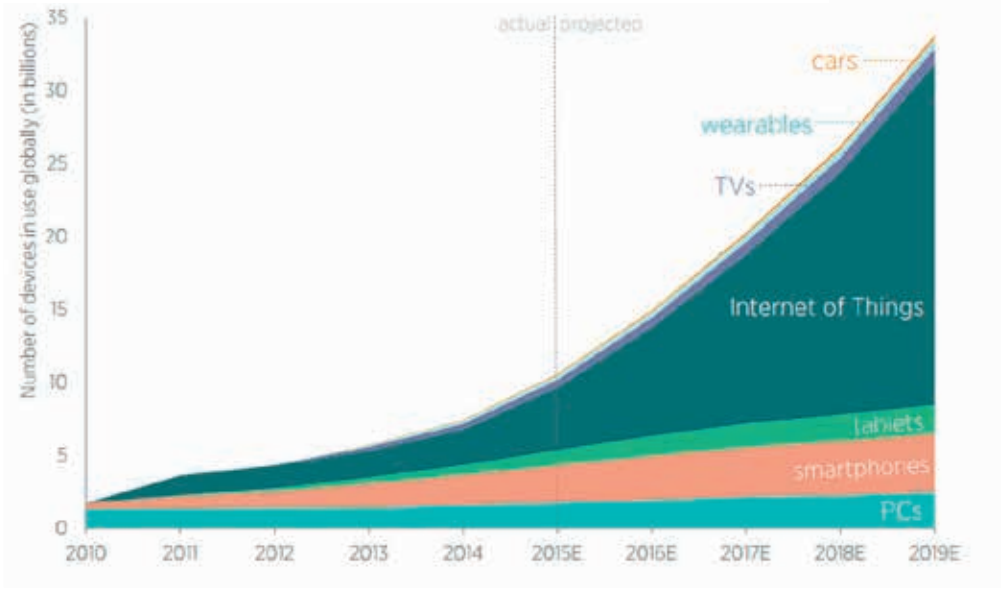
Figure 2. The Internet of Everything: Devices in Use Globally



Source: John Greenough, "The Internet of Everything 2015," *Business Insider Intelligence*. Produced by Adam Thierer and Andrea Castillo, Mercatus Center at George Mason University, 2015.

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IOT opportunities

McKinsey Global Institute - IOT Technologies on global economic impact US$2.7 trillion in 2015 to US$6.2 trillion in 2025 per year

Gartner says there will be 21 billion connected devices by 2020

GE Project – IOT Technologies could add US$15 trillion to global GDP by 2030

VisionMobile Project – IOT developers will grow from 300,000 in 2014 to 4.5 million in 2020

Top industries benefit
From IOT Technologies

Healthcare

Manufacturing

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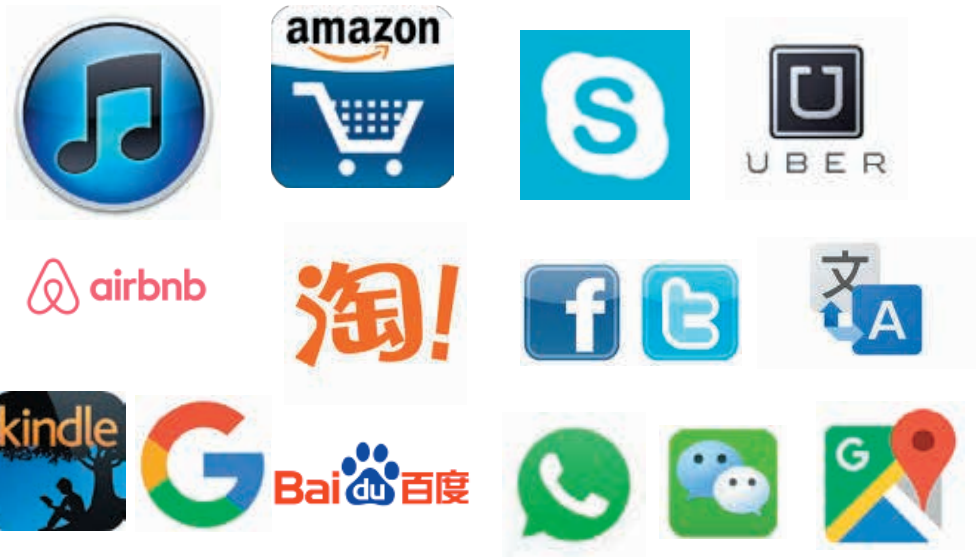
Digital Disrupted Business - Winners



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Digital Disruption – Winners & Losers

vodafone

- 439 Million Users
- 91,000 employees

skype™

- 750 Million Users
- 600 employees

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Mr. David Rose

Forbes
"New York Archangel"

BusinessWeek
"World Conquering Entrepreneur"

Crain's New York Business
"Father of Angel Investing in NY"

Best Selling Author
"Angel Investing"

Any Company Designed for the Success in the 20th Century is doomed to failure in the 21st Century

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Transformation Path

Dare to Dream

Strategize and Execute

Clear Vision

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8

Trend – Mass Customization "C – B"

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World of Operating Industrial Robots

806,000 industrial robots in 2014

3.2x

2,600,000 industrial robots in 2020

The International Federation of Robotics reports in 2015

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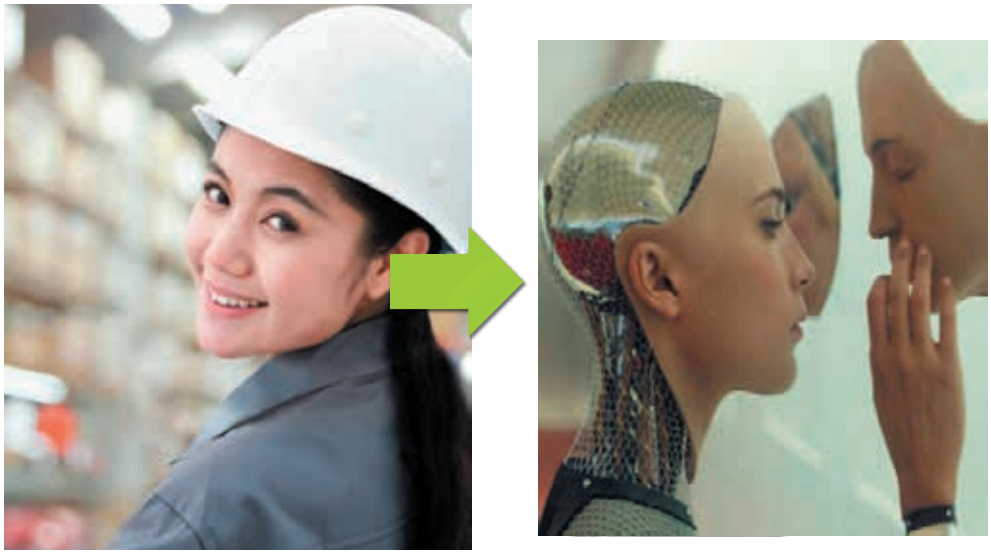
Facts to Accept



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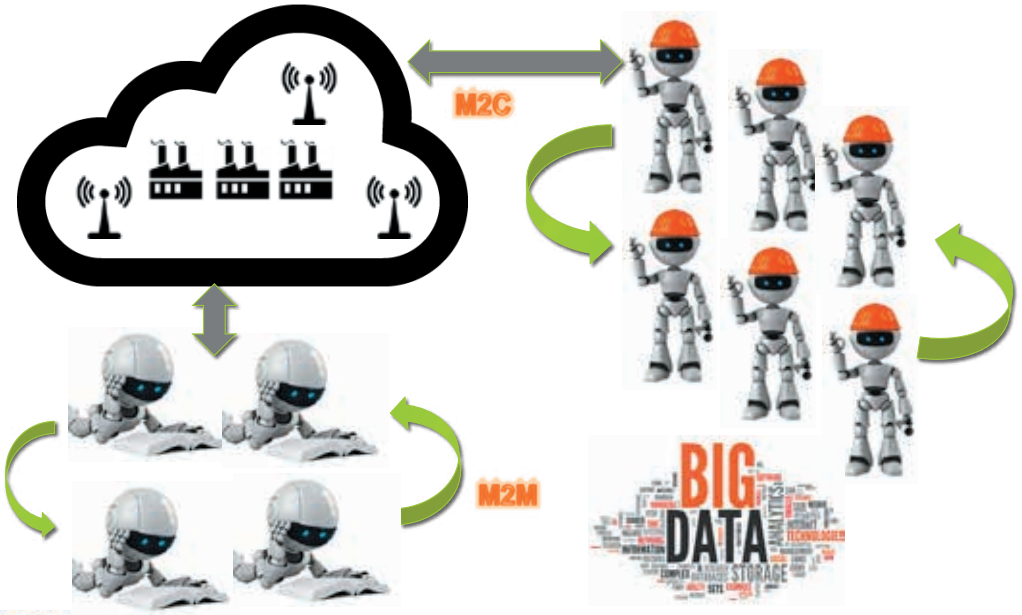
Machine to Machine Cloud Learning



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Next Age Interactive Robots

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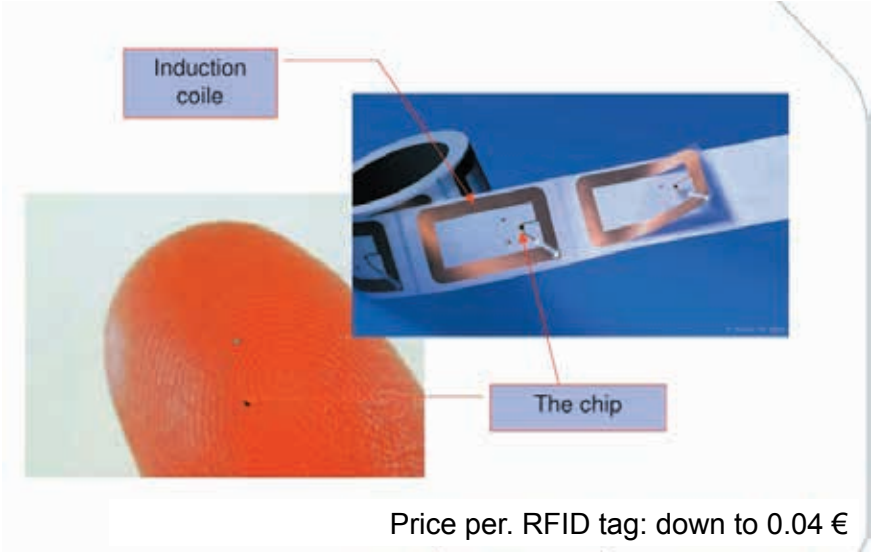
Trend - Mass Usage of RFID Tags



Price per. RFID tag: down to 0.04 €

Source: Tor Hjalmar Johannessen, Telenor

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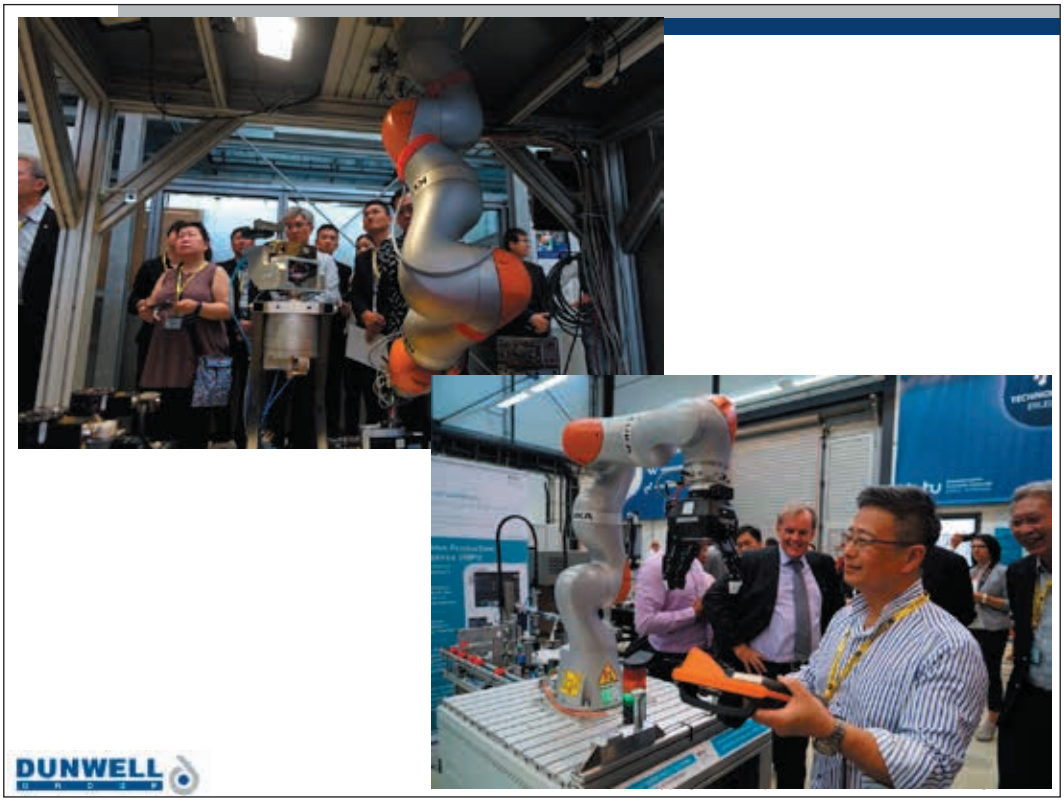
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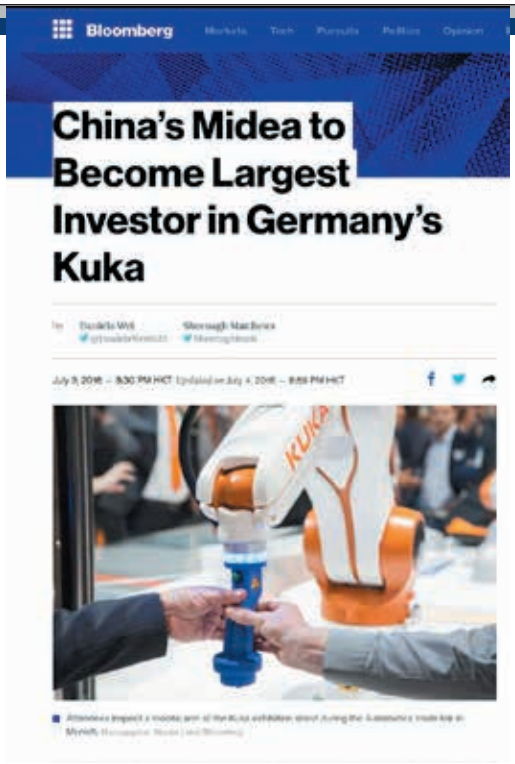

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Technology-Today

Source: Raffaello D'Andrea, TED Talks 2016

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Technology-Today

Source: Raffaello D'Andrea, TED Talks 2016

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WHERE ARE WE AT *TODAY'S* ENVIRONMENTAL TECHNOLOGY?

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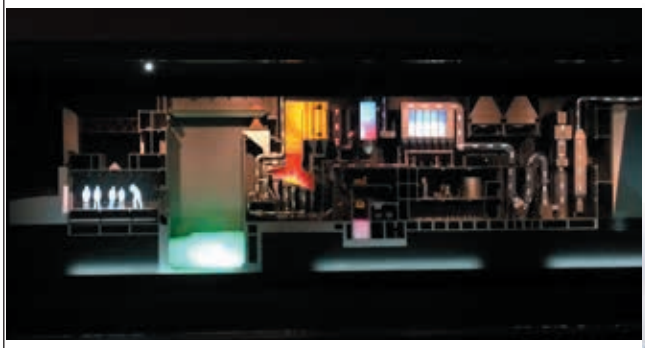
Integrated Waste Management Facilities



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WEEE Treatment and Recycle Facility

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Current Technology

Source: LNV, Inc

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Current Technology

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New Technology : *Fine Bubble Aerator*

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Fine Bubble Aerator

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Fine Bubble Aerator

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Old Technology

New Tech

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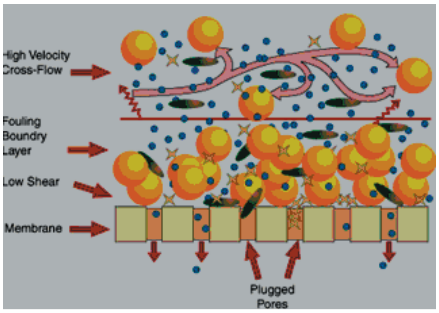
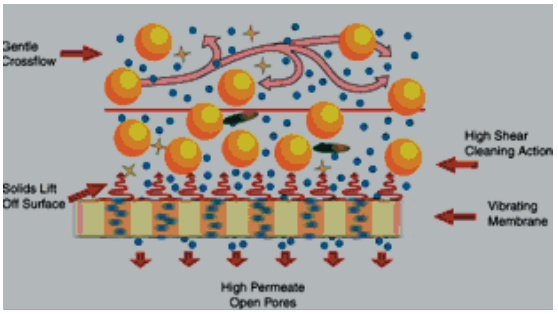
Vibrating Membrane Technology

Crossflow



Vibrating Membrane



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China's 1st Zero Liquid Discharge Coal Gasification Project at Inner Mongolia

Heshigten Banner, Inner Mongolia

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China's 1st Zero Liquid Discharge Coal Gasification Project at Inner Mongolia

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DOMESTIC WASTEWATER TREATMENT

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Membrane Bio-Reactor

Portable Toilet

Wastewater Reuse
Bio-Toilet

DMBR System

After
Treatment

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Remote monitoring and control system

The maintenance team gets SMS and email reminder from each MBR system

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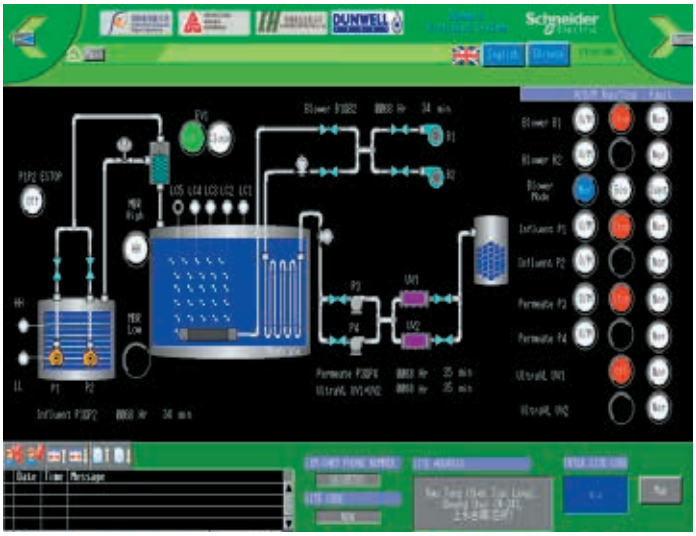
Remote monitoring and control system

Plant operator can monitor and control plant operation via Internet and Smart Phone



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Zero Carbon Building

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More than 140 Public toilets in Hong Kong

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Construction Site

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Tsing Dao Lao Shan Tourist Area Public Toilet

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At the factory

Lao Shan Tourist Toilet Installation

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Lao Shan Tourist Area Public Toilet Control Center

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QR Code at the tourist area public toilet

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FUTURE DEVELOPMENT?

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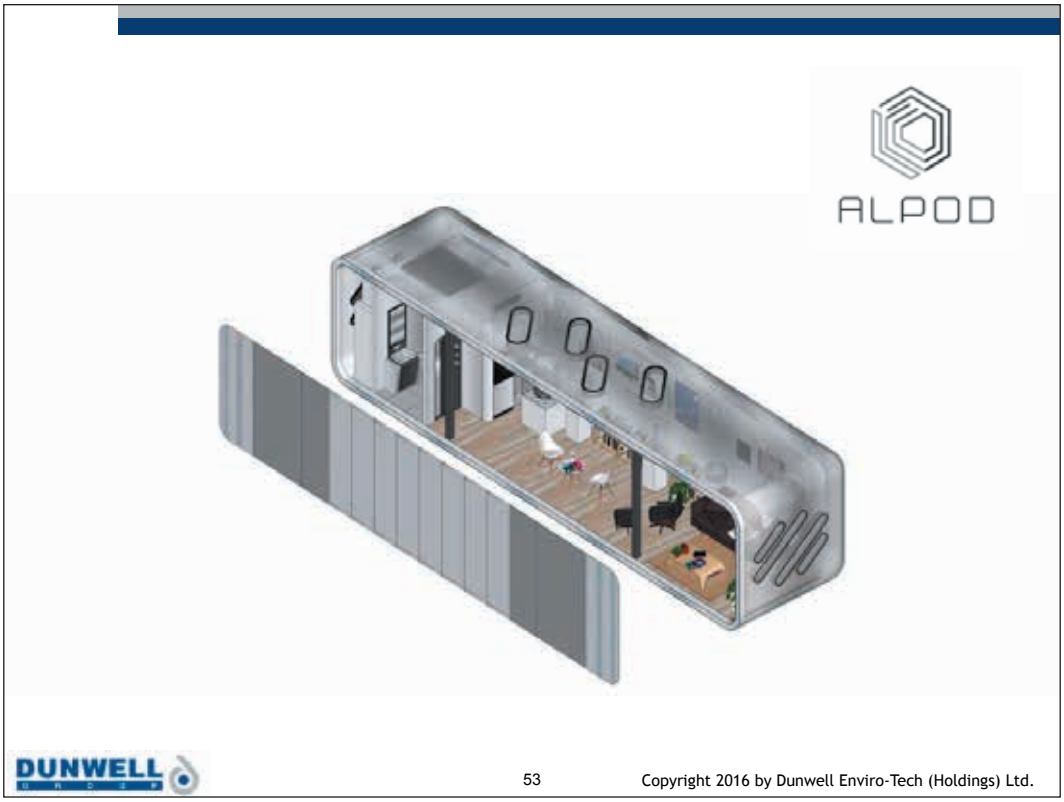
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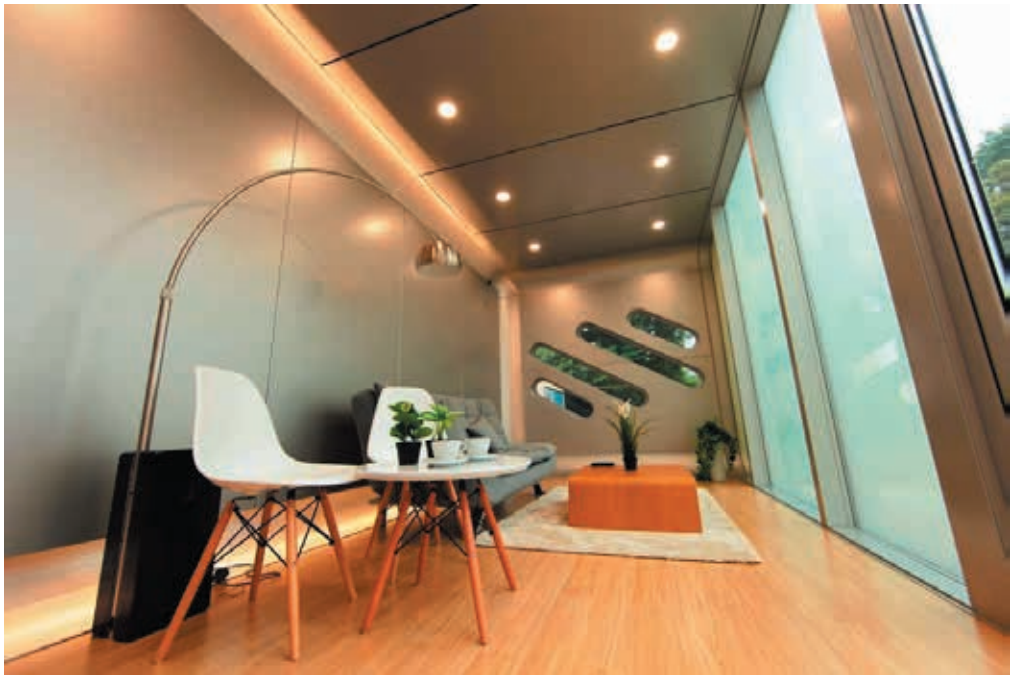

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多謝！
Thank You!

Acknowledgement to Dr. Jack Yeung, ACE Mold

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可持續發展與校園交通運輸之探討
A Study of Sustainable Campus Transportation in Macau

溫日明[1]　馮珮珊[2]
1. 澳門大學土木及環境工程系高級講師，澳門特別行政區
2. 澳門大學土木及環境工程系碩士生，澳門特別行政區

Introduction

Since the operation of new campus for University of Macau in Hengqin where is an island in Zhuhai and also special economic zone in the Guangdong province, a 20 times larger campus with 12,000 students capacity, it can be expected that a rapid development of University of Macau will be coming in the future. Growth of university community members could increase pressure to car usage and parking spaces, public transportation demand and challenge to environment, it is important to minimize those impacts in campus. Obviously, the answers of these problems lie on how to promote the sustainable development concept in the university campus environment. According to the report of the World Commission on Environment and Development (Board on Sustainable Development, 1999), sustainable development was defined as "the reconciliation of society's development goals with its environmental limits over the long time". A transportation system is defined as "sustainable" if it can satisfy current transport and mobility needs without compromising the need of future generations. (Richardson, 1999).

Implications of Campus Transportation Sustainability

University campus is considered as the best place for testing and implementing various sustainable transportation management and policy such as providing incentives for walking, cycling, taking public transport system, ridesharing, discouraging the use of single-occupancy cars etc. (Balsas, 2003). On the other sides, the University can affect not only the transportation behavior of the campus community but also the commuting habits and the environmental awareness that students can develop in the long time (Tolley, 1996).

Methodology

With an aim to understand the conditions of the sustainability of transportation on the UM campus, a questionnaire survey was designed and distributed to UM students for obtaining their perceptions about the campus transportation. Through the questionnaire, potential indicators related to sustainable transportation would be obtained. A preliminary selection of potential indicators is needed first.

Selection Criteria for Potential Indicators

Based on the recommendation of Hart (1997), indicators selected to assess the transportation sustainability for the case of UM must be able to obtain high-quality data easily. In other words, the data acquired through such indicators need to be accurate and easily available, be able to represent a large phenomenon of the case, be relevant to stakeholders (including users and policy makers), and be separated into short-term and long-term. Indicators of sustainable transportation should be related to the three main facets stated by Litman (2005), including economic, social and environmental ; but an adjustment is necessary to cope with the environment in the case of university campus. In consideration of the criteria of indicator selection and case studies from different campuses, four main directions are set up to select the potential indicators for sustainable transportation on the UM campus:

1) pedestrian-friendly campus,

2) environmental-friendly campus,

3) campus infrastructure improvement, and

4) green traveling behavior.

Measurement of Potential Indicators

The indicators can be measured by three methods, including questionnaire survey, direct measurement and secondary data research. The questionnaire survey would gauge opinion-based indicators, such as reasons of respondents' selection of traffic modes and their satisfaction level of public transport service. Direct measurement is used for indicators that can be measured directly, such as number of vehicles in car parks and number of buses arriving at a bus station in a particular period. Secondary data research is conducted for indicators related to professional knowledge, study reports or special equipment needed, such as emission of greenhouse gases from private vehicles and traffic noise on campus.

Data Availability for Indicators

The constraints that could affect the quality of data for establishing indicators might include the number and specialization of individuals working for the study, difficulty in searching specific resources for particular topics, and the size and scope of the study, and so on. For tackling these constraints and improving the reliability of this study, data availability for each indicator is evaluated based on three levels, respectively Grade A, Grade B and Grade C.

Grade A represents that a high quality of data can be obtained, such as the number of bus stops on campus which can be measured directly. Grade B represents that reliable data can be obtained, such as traveling behavior of students which would be obtained by the questionnaire survey. Grade C represents that the data obtained is not reliable or easily available, such as emission of greenhouse gases from private cars and public transportation on campus, as these areas of concern require professional crews and equipment to measure, and there is a lack of published research in the literature.

Selection of Indicators for the Study

The indicators for the UM campus to achieve sustainable transportation are grouped into different areas as below:

A. To determine the level of roads on campus:
   - A1. Coverage of road, sidewalk and cycling road on campus
   - A2. Quality of road, sidewalk and cycling road on campus

B. To determine traffic mode choice of students:
   - B1. Percentage of students who use private cars and motorbikes as primary traffic mode
   - B2. Percentage of students who use public transportation as primary traffic mode

C. Reasons for chosen traffic modes:
   - C1. Parking area and policy for private cars and motorbikes
   - C2. Policies to restrict private car use on campus
   - C3. Satisfaction level of public transportation
   - C4. Distance between each bus stop
   - C5. Service support for disabled people
   - C6. Incentives for using different traffic modes

D. Promotion of green travel:
   - D1. Walkability and bikeability of campus
   - D2. Landscape on campus
   - D3. Proper links or shortcuts between places
   - D4. Safety for road users

E. To determine the environment impact:
   - E1. Emission of greenhouse gases and wastes
   - E2. Use of renewable energy or low-emission energy in public transportation
   - E3. Noise pollution

Specific indicators related to each direction can be observed from Table 1 below.

Table 1Indicators with corresponding related directions

Main directions of indicators	Related indicators
Pedestrian-friendly campus	A1, B2, C5, C6, D1, D3, D4
Environmental-friendly campus	B1, C2, D2, E1, E2, E3
Campus infrastructure improvement	A1, A2, C1, C5, C6, D3
Green traveling behavior	B1, B2, C2, C3, C4, C6, D1, D2

A summary of the measurement method and data availability of each indicator is listed in Table 2 below. As mentioned previously, indicators can be measured by three methods, including questionnaire survey, direct measurement and data research.

Table 2 List of Potential Indicators

Indicator	Measurement method	Data availability
A1. Coverage of roads, sidewalks and cycling paths on campus	Direct measurement, Data research	B
A2. Quality of roads, sidewalks and cycling paths on campus	Direct measurement, Questionnaire survey	B
B1. Percentage of students who use private car, motorbike as primary traffic mode	Questionnaire survey	B
B2. Percentage of students adopting public transportation as primary traffic mode	Questionnaire survey	B
C1. Parking areas and policy for private cars and motorbikes	Questionnaire Survey,	
Data research	B	
C2. Policies to restrict private car usage on campus	Data research	A
C3. Satisfaction level of public transportation	Questionnaire survey	B
C4. Distance between each bus stop	Questionnaire survey,	
Data research	A	
C5. Service support for disabled people	Questionnaire survey,	
Data research	B	
C6. Incentives of using different traffic modes	Questionnaire survey	B
D1. Walkability and bikeability on campus	Direct measurement, Questionnaire survey	B
D2. Landscape on campus	Direct measurement,	
Questionnaire survey	B	
D3. Proper links or shortcuts between places	Direct measurement, Questionnaire survey	A
D4. Safety of roads for users	Data research	A
E1. Measurement of greenhouse gases and waste	Data research	B
E2. Use of renewable energy or low-emission energy in public transportation	Data research	A
E3. Noise pollution	Data research	C

Questionnaire Design

The sampling population of the questionnaire survey is students in UM. The questionnaire comprises 6 parts, including personal information; selection of traffic mode; satisfaction level of shuttle bus service on the UM campus; satisfaction level of public bus services between the UM campus and the city; usage of bicycle on campus; and opinions on accessibility facilities provided on campus.

Personal information: e.g. year of study, academic department, whether or not living on campus, whether or not holding a driving license.

Selection of traffic mode: e.g. respondents' perceptions about a series of subjects on a five-level Likert scale, such as the campus landscape, planning of roads, noise from vehicles, and whether the campus attracts them to travel on foot or by bike; as well as their primary traffic mode and the reasons of their selection.

Satisfaction of public transportation: frequency of use of shuttle bus and public bus services, as well as opinions on the period and accuracy of the routes, and the location and comfortability of the bus stops.

Usage of bicycle: frequency of biking on campus; ownership of bicycle; reasons of biking on campus.

Accessibility facilities: Taking into account that this is not a common topic for students, instead of seeking direct answers in the questionnaire, respondents were asked to provide their contact information for a follow-up meeting to discuss their use and perceptions of the campus accessibility facilities.

Pilot and Execution of Questionnaire Survey

Twenty students of UM were invited to take part in a pilot study of the questionnaire survey. The validity and reliability of the questionnaire was tested based on respondents' answers to the questions. In addition, their opinions were also considered in order to improve the contents and layout of the questionnaire to create a final version of the survey.

For the formal execution, an online survey form was adopted. A sampling size of 200 was targeted in the initial stage.

Direct Measurement and Data Research

Apart from the questionnaire survey, certain indicators were obtained by other methods. Indicators including the number of vehicles arriving at and departing the campus, and occupancy of parking lots were measured directly. Indicators including the policy of parking lots, and usage of renewable energy in public transportation were obtained by data research. Some of the indicators were measured by more than one method for a more comprehensive analysis.

Selected Results and Analysis

Selected Results from Questionnaire Survey

A total of 206 questionnaires were received, among which 54.4% were male and 45.6% were female; 40.1% stayed in residential colleges on campus and 59.9% did not. Year 1 to Year 4 students and postgraduate students respectively composed of 16.5%, 17%, 21.4%, 41.7% and 3.4% of the total number of respondents. The distribution of faculty affiliated by respondents is listed in Table 3. With regard to driving licence, 42.2% of respondents hold a motorcycle licence, 36.9% with a light vehicle licence, and 42.2% have neither of them.

Table 3Distribution of Faculty Affiliation

Faculty	Arts & Humanities	Business Administration	Education	Health Science	Law	Social Sciences	Science & Technology
Percentage	14.6%	19.9%	11.2%	1.9%	4.4%	13.6%	34.5%

Perceptions of transportation environment on campus:

Perceptions of the walking environment, sidewalks, cycling paths and roads, such as their comfortability, safety and accessibility, were obtained to assess the campus transportation environment. For instance, as shown in Table 4, respondents rated their satisfaction towards various aspects of the walking environment on campus. While the campus landscape was generally evaluated as satisfactory, the other two aspects were less acceptable in general.

Table 4Satisfaction Levels of Various Aspects of Campus Walking Environment

5-point Likert scale % of valid results	**Extremely Satisfied (5)**	**Satisfied (4)**	**Neutral (3)**	**Dissatisfied (2)**	**Extremely dissatisfied (1)**
Landscape	15.6%	46.3%	29.8%	6.8%	1.5%
Trees and facilities along roads with sunshades	6.8%	15.6%	29.8%	34.1%	13.7%
Connectivity between buildings	6.4%	21.1%	43.1%	24.0%	5.4%

The other indicators concerning sidewalks, cycling paths and roads scored fairly high levels of satisfaction.

Traffic mode selection:

Several questions related to traffic mode selection were asked in the survey, including respondents' primary choices of their daily trips within campus, and those between campus and city; their acceptable traveling time within campus; and their reasons of choosing public transportation or private vehicles.

The results about the traffic mode within campus, for example, indicate that many respondents choose green commuting methods, including walking (47%), cycling (17%), and using public transportation (17%), to move around the campus. While choosing the traffic mode to travel between the campus and the city, more than half of the respondents would use public transportation, and the other 28.6% and 14.6% would respectively choose motorcycle and light vehicle. Getting to know the reasons why students would prefer public transportation to other modes, and vice versa, would help us realize what kinds of planning and policy could achieve a more sustainable campus transportation. The three major reasons for students to use public transportation included cost, convenience and weather conditions. Students prefer private vehicles primarily due to shorter traveling time, free parking spaces provided on campus, as well as convenience.

Services of campus shuttle bus and public transportation:

Respondents were asked to rate the various aspects of the shuttle bus service provided on campus and the public transportation between the campus and the city, including locations and comfortability of bus stops, time intervals and punctuality of the service, as well as overall satisfaction level. With regard to the campus shuttle, for instance, while respondents were less satisfied with the stop locations and time intervals of service; they were happy about the comfortability of the bus stops and the punctuality of service. Compared to the campus bus service, the public bus transportation was less satisfactory in all the areas of concern.

Cycling on campus:

Of the 44% of the total respondents, who have cycled on campus, daily commuting was the reason of cycling on campus for many (81.3%), while physical activity was the second popular reason (23.1%). Other indicators were also asked concerning cycling on campus, including bike ownership, frequency of cycling, as well as accidents, such as occurrence, location and cause.

Campus car parking:

Direct measurement was adopted to assess the capacity and usage of car parks on campus. Comparison of usage of car parks in peak and non-peak periods is listed in Table 5 below.

Table 5Comparison of usage of car parks in peak and non-peak period

	Peak Period				Non peak Period			
	Light vehicle		Motorcycle		Light vehicle		Motorcycle	
	Normal	Disabled	Normal	Disabled	Normal	Disabled	Normal	Disabled
P1	100%	0%	75%	0%	81%	50%	68%	0%
P2	81%	0%	82%	0%	24%	0%	13%	0%
P3	68%	25%	31%	0%	64%	0%	17%	0%
P4	69%	25%	45%	0%	19%	0%	15%	0%
P5	85%	17%	66%	0%	61%	8%	24%	0%
P6	16%	50%	30%	0%	45%	0%	37%	0%
P7	10%	0%	5%	0%	16%	0%	9%	0%

In short, occupancy of parking lots by light vehicles is normally higher than that by motorcycles in most of the car parks. During peak periods, car parks P1-P5 had more than 65% of usage, and the average percentage of usage of these five car parks is 81%. During off-peak periods, P1, P3 and P5 had more than 60% of usage, and the average percentage of usage of these three car parks is 69%. To monitor a reasonable usage of car parks to satisfy the existing demand and future growth of campus, policy is necessary to restrict users' intention of driving private vehicles to campus, such as setting up parking fees or promoting a carpooling program.

Selected Results from Direct Measurement

Traffic composition of arriving and departing vehicles:

In order to count the number of arriving and departing vehicles, a video camera was set up at the campus gateway of the river tunnel linking between the campus and the city of Taipa, and a 12-hour video was recorded on 24th March. Graphic summaries of the arriving and departing vehicle counts are shown in Figures 1 and 2.

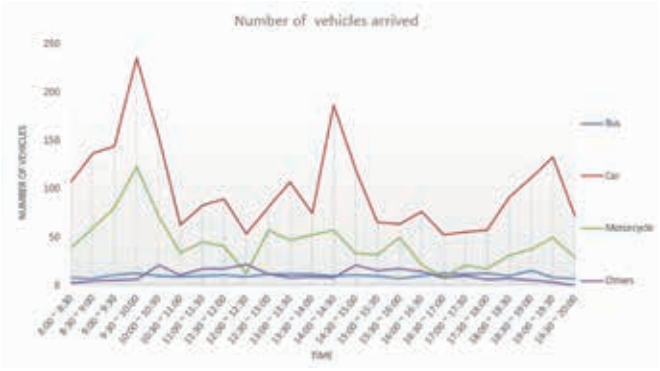

Figure 1Number of vehicles arrived at campus in 12-hour measurement.

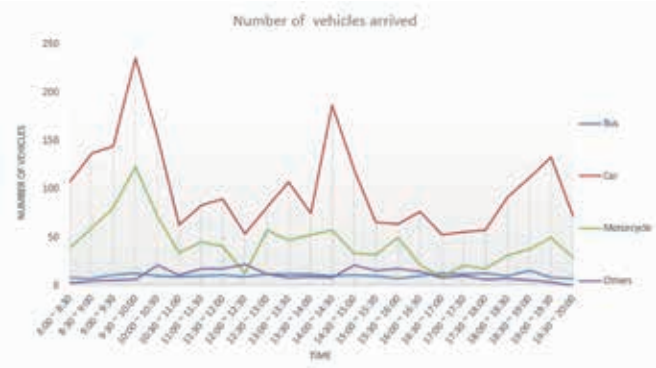

Figure 2Number of vehicles departed from campus in 12-hour measurement.

Three peaks are found for the arriving vehicle number, and two peaks for the departing vehicle number, largely reflecting the starting times of class (including evening programs) and work, and the finishing times of class and work.

Emission measurement of vehicles on campus:

In order to estimate the emissions of arriving and departing vehicles on campus, the following steps were carried out:

1) Obtain the emission factors of different types of vehicle, in g/km.
2) Obtain the traveling distance (km) of different types of vehicle in 12-hour measurement period (from 08:00A.M. to 08:00 P.M.).
3) Calculate emissions of arriving and departing vehicles, by multiplying the result from step 1 and the result from step 2, in gram.

Steps of calculation for emission of arriving and departing vehicles are listed below:

Table 6Number of vehicles in 12-hours measurement period

	Bus	Car	Motorcycle	Others
Arriving vehicle	250	2412	1048	248
Departing vehicle	236	2149	912	268
Total	486	4561	1960	516

Table 7Proportion and distance from terminals to campus for public transportation buses.

	PRACA FERREIRA AMARAL	EDF. CHUN LUEN	TJOI LONG SEA VIEWI BLOOO 1	AV. 1° DE MAIO
Percentage	25%	25%	25%	25%
Distance (km)	8.5	4	7	13.8

Table 8Proportion and distance from each parish to campus for car.

	Nossa Senhora de Fátima	Santo António	São Lázaro	São Lourenço	Sé	Nossa Senhora do Carmo (Taipa)	Zona de Aterro centre Taipa e Coloane	São Francisco Xavier (Coloane)	Other
Percentage	37%	21%	4%	6%	5%	27%		0%	
Distance (km)	13	11.5	11	8	9.2	7		3	

Table 9Proportion and distance from each parishes and campus for motorcycle.

	Nossa Senhora de Fátima	Santo António	São Lázaro	São Lourenço	Sé	Nossa Senhora do Carmo (Taipa)	Zona de Aterro centre Taipa e Coloane	São Francisco Xavier (Coloane)	Other
Percentage	49%	17%	9%	6%	5%	10%	1%	0%	2%
Distance (km)	13	11.5	11	8	9.2	7	1.5	3	

Table 10Total traveling distance = number of vehicles x proportion x distance

	Distance from each proportions (km)								Total (km)
Campus bus	272								272
Bus	1032.8		486		850.5		1676.7		4046.0
Car	21938.4	11014.8	2006.8	2189.3	2098.1	8620.3		0	47867.7
Motorcycle	12485.2	3831.8	1940.4	940.8	901.6	1372.0	29.4	0	21501.2
Others	2482.0	1246.1	227.0	247.7	237.4	975.2		0	5415.4

Table 11Emission of vehicle in 12-hours measurement period, unit in gram.

	Campus bus	Bus	Car	Motorcycle	Others	Total
NOx	3265.1	48567.6	2824.2	5740.8	19273.5	79671.2
PM10	96.6	1436.3	191.5	580.5	731.1	3036.0
PM2.5	89.8	1335.2	191.5	537.5	676.9	2830.9
THC	68.0	1011.5	5983.5	40465.3	6287.3	53815.5
CO	1076.6	16013.9	43942.5	135414.6	23270.1	219717.6
SO2	1.6	23.4	79.5	6.9	12.8	124.1

Summary of Results of Indicators

The results of indicator can be shown in two methods, including:

A) Mark or significant value of the indicator;

B) Statement for the existing condition of indicator.

A summary of the results of all indicators is listed in Table 12.

Table 12Summary of all results of indicators.

Indicator	Result
Coverage of road, sidewalk and cycling paths on campus	A. Marks of accessibility of road and cycling road are 3.5 and 3.3 out of 5 respectively. B. Lack of cycling road in East and North District.
Quality of road, sidewalk and cycling paths on campus	A. The marks of quality of road, sidewalk and cycling road are 3.8, 3.6 and 3.6 out of 5 respectively.
Percentage of students who use private car or motorbike as primary traffic mode	A. 14.6 % of student use private car and 28.6 % of student use motorcycle as primary traffic mode.
Percentage of students who use public transportation as primary traffic mode	A. 54.9% of student use public transportation as primary traffic mode.
Parking area and policy for private car and motorbike	A. 81% of light vehicle occupancy in the 5 highest usage car parks in peak period 69% of light vehicle occupancy in the 3 highest usage car parks in non-peak period. B. Free of parking fee, permit is needed to use staff car park
Policies to restrict private car usage on campus	A. No policy is developed yet to restrict private car usage.
Satisfaction level of public transportation	A. The marks of satisfaction of public bus and campus bus service are 6.1 and 7.2 out of 10 respectively.
Distance between each bus stop	A. 64% of respondent thought the location of bus stop of public transportation service is reasonable; 46 % of respondent thought the location of bus stop of campus bus is reasonable.
Service support for disabled people	A. 8.7% of respondents have been used; 61.1% of them responded the support is enough.
Incentives of using different traffic modes	A. 42.2% of respondent thought the main incentive of bus is the cost; 62.9% of respondent thought the main incentive of bus is the shorter traveling time.
Walkability and bikeability on campus	A. 40% of campus area can be arrived within 10 minutes by walking; 80% of campus can be arrived within 2 minutes by cycling.
Landscape on campus	A. The mark of landscape in campus is 3.6.
Proper links or shortcuts between places	A. The mark of connectivity of buildings is 3 mark B. Most of buildings except North District are connected by footbridge without cover.

Indicator	Result
Safety of roads for users	A. 16.5% of respondents had accident while traveling in campus; 50% of them thought the cause of accident was the geometric design of roads. B. Non-clear separation of different types of roads in East District.
Measurement of greenhouse gases and waste	A. 48568 g of NOx, 1436 g of PM10 and 1335 g of PM2.5 are discharged by public transportation bus; 40465 g of THC is discharged by motorcycle; 43943 g of CO and 79 g of SO2 are discharged by car
Use of renewable energy or low-emission energy in public transportation	Unable to obtain in this study
Noise pollution	Unable to obtain in this study

By combining these two types of results of indicators, a more comprehensive understanding of indicator performances can be obtained. For instance, the high occupancy of parking spaces and a lack of policy to restrict private vehicle usage show that the demand of parking spaces on campus is high and policies are necessary to reduce the private vehicle usage. For the environmental indicators, the amount of emissions of vehicles was calculated, but other aspects of environmental impact such as noise pollution were not determined because of the lack of professional equipment. Therefore, a comprehensive measurement in environmental aspects can be done in future research.

Conclusion

The purpose of this study was to assess the relationship between sustainability and transportation on the new UM campus by establishing a set of indicators. With more than 10,000 people studying and working in UM, this case study can serve as a reference for small-scale cities. The main method to assess the transportation sustainability on campus is to set up a series of indicators aiming at different aspects. Potential indicators should be able to represent the phenomenon on campus, which help decision makers to take action for improvement. Indicators in different periods can be compared to find out to what extent particular policies are effective and to what extent the campus is employing sustainable transportation.

For future study, as the results of indicators in different periods can be used for monitoring, indicator performance can be measured towards a 3-year or 5-year goal. The questionnaire survey can be adjusted to obtain other potential indicators, such as perceptions of carpooling and car sharing programs.

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從香港城市規劃策略的區域視角看粵港澳大灣區的可持續發展

凌嘉勤先生，JP
香港特別行政區規劃署署長

本文從區域的視角，介紹香港的城市規劃策略如何對粵港澳大灣區的可持續發展作出貢獻。

一、粵港澳大灣區概念的誕生與香港的角色

早在2006至2009年間，粵港澳三地政府攜手合作進行了《大珠三角洲城鎮群協調發展規劃研究》，總結了粵港澳三地合力建設世界級城鎮群，其中的發展目標包括將區域建設成宜居的優質生活圈。

在2010至2014 年，三地政府共同編制《環珠江口宜居灣區建設重點行動計劃研究》[1]。研究為環珠江口灣區提出了可持續發展及宜居發展的需要、目標和策略行動，並圍繞六大宜居元素，讓各個相關城市各自按獨特的情況和制度設定行動計劃,對應「低碳生態灣」的發展目標[2]。研究的成果使粵港澳三地政府的區域性合作從經濟合作和發展，跨越到全面的宜居考慮。

粵港澳大灣區的新使命—經濟發展與生態文明並行

2015及2016年國家公佈的《推動共建「一帶一路」的願望與行動》和《深化泛珠三角區域合作的指導意見》（下稱《指導意見》），明確提出讓廣州、深圳與港澳合作共同建設世界級城市群，構建「粵港澳大灣區」。《指導意見》亦提出生態文明建設先行先試區的定位，並支持港澳與內地九省區開展大氣污染防治及環保科研合作。

二、香港城市規劃策略

香港正是在「一帶一路」上，國內企業「走出去」、國際企業「引進來」的交匯點。除了擔當著「超級連繫人」的角色，香港的城市規劃提供的空間條件都將促進「粵港澳大灣區」的可持續發展。

1. 區域視角下的城市規劃策略框架

香港在區域視角下的城市規劃策略，由三個主要部份構成：(1) 堅守宜居城市的可持續發展原則，包括：公交（鐵路）導向、回應氣候變化、智慧、具抗逆能力、保育生態環境及資源；(2) 鞏固和提昇香港的核心優勢（包括支柱產業、創新聯繫能力、人才集聚、基建配套和制度優勢）；以及(3)提供充裕的經濟用地（包括發展商業中心區、新發展區，以及結合大型交通基建發展新的經濟活動節點）。

圖一：區域視角下的城市規劃策略框架

[1] 環珠江口宜居灣區包括珠江口7個濱水城市（即香港、澳門、深圳、東莞、廣州、中山和珠海）
[2] 根據六大宜居元素，提出十項專項行動建議，包括綠網、藍網、公共服務網、宜居社區、區域公共交通網、便捷通關、步行城市、特色公共空間、文化街區和跨界環保合作。

2. 宜居城市的規劃原則

為達到宜居、優質的生活和工作環境的目標，香港的城市規劃採納緊密聯繫、獨特多元的原則，建設充滿活力、健康、包容和支援社區的城市，吸引香港的市民、及海外的人才和企業家來港工作、創業和生活。

公交(鐵路)導向

香港是「公交(鐵路)導向型發展」的成功範例，並進一步規劃增建鐵路的覆蓋網絡。根據《鐵路發展策略2014》，五條正一同上馬興建的鐵路線將在未來數年陸續完成之際[3]，亦已前瞻性地規劃另外六條的鐵路路線[4]，使全港整體的公共交通的乘客量佔總體的乘客量保持在90%的水平。

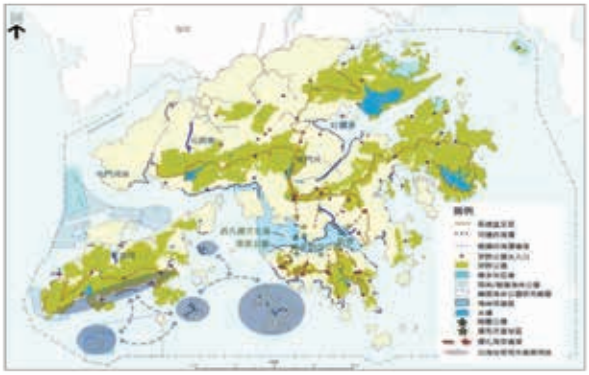
用地規劃方面，會維持以鐵路車站為節點的空間佈局，堅持集約緊湊的土地開發模式。目前，在全港鐵路車站500米的半徑範圍內，能夠覆蓋了全港77%的商業總樓面面積和45%的住宅單位數目。此外，貫徹混合用地、發展地下空間的三維化的城市設計原則，確保人、車流動順暢，增加規模經濟效益，便利生活及工作上的資訊和意見交流，減少開發城市邊緣用地的需求。同時，工作與社區設施就近，減少出行時間，提升生活質素。

回應氣候變化

在帶動區域發展的同時，香港作為國際城市也擔當起妥善管理環境的責任，協力應對氣候變化的挑戰，締造健康的城市。因此，都市氣候和城市通風成為了我們規劃設計城市的必要考慮要素。圖二顯示規劃署2012年完成的《香港都市氣候規劃建議圖》，作為策略性及地區性規劃項目的指引，例如規劃設計大型的發展項目時，必須進行通風評估和制定總體景觀藍圖，促使營造清新空氣暢通、溫度適宜、綠色的城市環境。

圖二：香港都市氣候規劃建議圖

我們將繼續優化公共空間的設計，增加休憩綠地的數量與質量，善用水體和山地的天然資源，例如全面整合水塘河道郊野公園及城市公園(圖三)；目前已經達到平均每人超過100平方米植被覆蓋的水平，城市公園配置達到平均每人超過2.5平方米，這都是締造健康城市的有利條件。



圖三：香港水塘、郊野公園及其他公園分佈

我們亦倡議城鄉共融，讓城市發展與鄉郊相互協調，例如在新發展區保留農地之餘亦推動自然保育，有助增加新發展區的植被及綠化覆蓋。又推廣步行，規劃設計融合五大元素[5]的步行環境，令城市綠色宜居，亦回應氣候變化。

[3] 包括西港島線、南港島線(東段)、觀塘線延線、沙田至中環線(大圍至紅磡、紅磡至金鐘)
[4] 包括北環線、屯門南沿線、東九龍線、東涌西延線、被港島線、南港島線(西段)。
[5] 即融合購物街道、休憩用地、行人專區、通風廊、視覺走廊等五大功能的步行環境

智慧、具抗逆能力

香港積極採取符合智慧、具抗逆力的城市發展策略，推動低碳的智慧型經濟和生活模式的發展，並會建設綜合智慧、環保、具抗逆力的基礎設施系統，涵蓋建築、排水、供水、蓄洪、廢物處理等各個方面。例如東九龍啟德發展區的區域供冷系統。這項工程不但可大大降低電力的消耗，帶來巨大的環境效益，而且帶動了水體的循環流動，解決啟德內灣的水質問題。

生態環境及資源保育

香港的環境生態系統與整個區域的環境質量息息相關。在保育40%的陸地為郊野公園的基礎上，會積極探討新途徑提高生物多樣性，並將其納入前期規劃中考慮。2010年至今，規劃署已將偏遠53幅的郊野公園「不包括土地」納入法定圖則，加強了生態生境的保育，有助保護香港的生態網絡，擴大香港整體的環境容量。

另外，亦倡議在活化河道方面，透過地方營造，將河道與景觀設計結合，塑造生態生境，並規劃休憩康樂空間，創造融合自然生態保育、綠化、健康舒適、人性的公共空間。

3. 經濟用地規劃

增加經濟用地，推動產業持續發展

香港向來都是跨國企業建立區域總部或貿易公司以管理亞太區業務的首選地方之一，會在依據宜居城市的規劃的原則上，確保經濟用地供應充裕，提供用地發展優質商業設施，吸引海外以及內地的企業首選在香港設立地區總部，善用香港的金融及商貿優勢。

為促進知識型經濟的發展，會配合大專院校，規劃更多科技及科研交流的空間和設施，形成「官產學研」的發展格局，使產業發展能發揮集聚效應，增加土地發展的效益。

為配合「再工業化」，推動智慧生產、吸引高科技產業和高增值生產工序，協助工業升級轉型，已採取不同的土地規劃包括活化工業大廈，善用現有的土地資源，增加多元經濟的容納量。

香港經濟用地的規劃項目

為配合以上發展和用地需求，會營造和加強3個經濟用地的發展方向，包括：首先，擴大傳統商業中心區，包括推動九龍東轉型為香港的第二個核心商業區，並研究在香港大嶼山東部水域進行填海，發展香港第三個商業中心區的可行性。再者，在新界地區發展多個新發展區及新市鎮擴展區。另外，利用大型的交通樞紐帶來的便利大量人流交匯的優點，開發新的商業功能區。

圖五顯示的新發展項目共可提供約940萬平方米的商業樓面面積，約等於中環寫字樓樓面面積總存量的3.5倍，並能容納約66萬個各類工商職位。這些經濟用地和就業機會都在住宅用地附近佈置，目的是配合職住平衡的發展需要，減低對交通需求。這個也是宜居城市和可持續發展的原則。

圖五：經濟用地規劃項目

4. 跨界交通基建規劃

為了促進粵港澳大灣區及更大區域的持續發展，會加強跨界交通基建配套建設。包括增建香港國際機場第三跑道、興建港珠澳大橋、增建直通機場島和港珠澳大橋口岸島的跨海隧道、建設廣深港高鐵香港段及西九龍總站、西九龍口岸、港珠澳大橋香港段及口岸、以及蓮塘/香園圍口岸及連接道路。在規劃各項基建和建設時，都會進行環境影響評估，提出和實行可緩解環境及生態影響的措施，從而確保經濟與環境的平衡發展。

總結

香港的城市規劃能夠提供的空間條件和方向，都將促進粵港澳大灣區的可持續發展。香港作為一個高效和可靠的合作平台，有利生產要素「走出」和「引進」大灣區，並提供密切交往的橋樑，促進川流不息的互動，保持大灣區發展的生機。香港亦會建設宜居綠色的環境，擴大環境容量，讓發展與環境共生共榮，使灣區滋養群才、孕育均衡的成長。

（作者/講者：凌嘉勤，香港特別行政區政府規劃署署長）

Brominated flame retardants in mangrove sediments of the Pearl River Estuary, South China: Spatial distribution, temporal trend and mass inventory

Zai-Wang Zhanga,e, Yu-Xin Suna,*, Kai-Feng Suna, Xiang-Rong Xua,*, Shen Yub, Tian-Ling Zhengc, Xiao-Jun Luod, Yun Tianc, Yong-Xia Hua, Zeng-Hui Diaoa, Bi-Xian Maid

a Key Laboratory of Tropical Marine Bio-resources and Ecology, Guangdong Provincial Key Laboratory of Applied Marine Biology, South China Sea Institute of Oceanology,
Chinese Academy of Sciences, Guangzhou 510301, China

b Key Laboratory of Urban Environment and Health, Institute of Urban Environment, Chinese Academy of Sciences, Xiamen 361021, China

c State Key Laboratory for Marine Environmental Sciences and Key Laboratory of the Ministry of Education for Coastal and Wetland Ecosystem, School of Life Sciences, Xiamen University, Xiamen 361005, China

d State Key Laboratory of Organic Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, China

e University of Chinese Academy of Sciences, Beijing 100049, China

*Corresponding authors. Tel.: +86 20 89100753.

E-mail addresses: sunyx@scsio.ac.cn (Y.-X. Sun), xuxr@scsio.ac.cn (X.-R. Xu).

ABSTRACT

Sediments were collected from three mangrove wetlands in the Pearl River Estuary (PRE) of South China to investigate spatial and temporal distributions of polybrominated diphenyl ethers (PBDEs), decabromodiphenyl ethane (DBDPE) and 1,2-bis(2,4,6-tribromophenoxy)ethane (BTBPE). Concentrations of ∑PBDEs, DBDPE and BTBPE in mangrove sediments of the PRE ranged from 1.25-206, 0.364-34.9, and not detected-0.794 ng g-1 dry weight, respectively. The highest concentrations of ∑PBDEs, DBDPE and BTBPE were found at the mangrove wetland from Shenzhen, followed by Zhuhai and Guangzhou, showing the dependence on the proximity to urban areas. PBDEs were the predominant brominated flame retardants (BFRs) in mangrove sediments. The concentrations of ∑PBDEs, DBDPE and BTBPE in sediment cores showed an increasing trend from the bottom to top layers, reflecting the increasing usage of these BFRs. The inventories of ∑PBDEs, DBDPE and BTBPE in mangrove sediments were 1962, 245, and 4.10 ng cm-2, respectively. This is the first study to report the occurrence of DBDPE and BTBPE in mangrove ecosystems.

Keywords: Brominated flame retardants, Distribution, Sediment, Mangrove, the Pearl River Estuary

1. Introduction

Brominated flame retardants (BFRs), as important additive/reactive flame retardants, have been widely used in electronics, paints, textiles, thermoplastics, polyurethane foams and building materials to reduce the flammability of many combustible products. Currently, at least 75 chemicals have been classified as BFRs (Alaee et al., 2003). Among them, polybrominated diphenyl ethers (PBDEs) have been widely used and are ubiquitous pollutants in the environment. There have been three major PBDE commercial formulations: Penta-BDE, Octa- BDE and Deca-BDE. Penta--BDE and Octa-BDE commercial products have been added to the list of emerging persistent organic pollutants (POPs) by the Stockholm Convention in May 2009 because of their persistence, bioaccumulation and toxicity, while Deca-BDE technical mixtures, banned in Europe and the United States of America, are still used in China (Besis and Samara, 2012). Due to restrictions and bans on the use and production of PBDEs, decabromodiphenyl ethane (DBDPE) and 1,2-bis(2,4,6-tribromophenoxy)ethane (BTBPE) have been used as replacements for Deca-BDE and Octa-BDE technical mixtures in various products, respectively. Although information

regarding the environmental behaviors of DBDPE and BTBPE is limited, the available data show that these alternative BFRs may also be persistent, bioaccumulative, toxic, and subject to long-range transport (Covaci et al., 2011).

Mangrove ecosystems, the intertidal wetlands along the tropical and subtropical coastlines, are rich in biodiversity and provide habitats for a wide variety of fauna and flora. Although their ecological and economic importance has received great attention, mangrove ecosystems, as one of the most threatened biogeocenoses, have been subjected to increasing pollution pressure from human activities due to rapid urbanization and industrialization in coastal regions (Lewis et al., 2011; Bayen, 2012). Mangrove sediments act as sinks for varieties of organic pollutants because of their unique properties such as abundant detritus, high organic carbon content, anoxic/reduced conditions, and rapid turnover and burial (Tam et al., 2006; Vane et al., 2009). Contamination of polychlorinated biphenyls, organochlorine pesticides and polycyclic aromatic hydrocarbons has been frequently reported in mangrove sediments (Vane et al., 2009; Bayen, 2012). Meanwhile, PBDEs have also been found in biotic and abiotic samples from mangrove wetlands (Bayen et al., 2005; Binelli et al., 2007; Qiu et al., 2010; Bodin et al., 2011; Zhu et al., 2014), but information on the occurrence of DBDPE and BTBPE is scarce. Therefore, monitoring data on DBDPE and BTBPE in mangrove ecosystems are essential to get better understanding of their environmental behaviors.

The Pearl River Estuary (PRE), located in the Pearl River Delta (PRD) region of South China, has become one of the most developed and urbanized regions in China. The PRE has acted as a major reservoir for man-made contaminants discharged from municipal sewage, industrial waste, and upstream runoff, which may pose adverse effects to mangrove ecosystems (Zhang et al., 2014). In addition, intensive electrical waste (e-waste) recycling activities emerged in the PRD region in the last decades, which have released large amounts of BFRs into the PRE environment. It has been estimated that 23 metric tons of PBDEs were discharged into the PRE during the last 20 years (Guan et al., 2007). Thus, the PRE is generally regarded as a hotspot for BFR contamination. More recently, relatively higher levels of PBDEs (1.71-114 ng g-1 dry weight, dw) have been reported in mangrove sediments from Hong Kong, South China (Zhu et al., 2014). However, data on spatial distribution and temporal trend of BFRs (especially for DBDPE and BTBPE) in mangrove ecosystems of the PRE is limited.

In the present study, sediments from three mangrove wetlands in the PRE were collected and analyzed for the levels of PBDEs, DBDPE and BTBPE. The objectives of this study were to (1) explore the occurrence and spatial distribution of these BFRs in mangrove wetlands in the PRE, South China; (2) investigate temporal trend of BFRs in mangrove wetlands; (3) estimate the mass inventory of BFRs in mangrove wetlands. To the best of our knowledge, this is the first study to investigate the distribution and temporal trend of DBDPE and BTBPE in mangrove ecosystems.

2. Materials and methods

2.1. Sample collection

A total of 30 surface sediments and 3 sediment cores were collected between October and November 2012 from three main mangrove wetlands in the PRE, South China, namely Futian Mangrove Nature Reserve in Shenzhen, Qi'ao Island Mangrove Nature Reserve in Zhuhai, and Tantou Mangrove Nature Reserve in Guangzhou (Fig. 1). The dominant mangrove species in Shenzhen, Zhuhai and Guangzhou mangrove wetlands are Kandelia candel, Sonneratia apetala, and Aegiceras corniculatum, respectively. The top 5 cm layer of surface sediments was collected with

a stainless steel grab sampler. Five sub-samples were randomly collected to mix a composite sample at each sampling point with an area of 5 m × 5 m. The sediment cores were collected from the middle of the natural swamps of each mangrove nature reserve using a gravity corer and sectioned at 4 cm intervals. All the sediment samples were immediately transferred to the laboratory and stored at -20 oC prior to chemical analysis.

2.2. Sample extraction and cleanup

The extraction and cleanup procedures for BFRs in mangrove sediment samples were described by Chen et al. (2013). Briefly, sediment samples were freeze-dried, grounded, homogenized by passing through a stainless steel 80-mesh sieve (0.2 mm) and stored in dark glass containers at -20 oC prior to extraction. Approximately 10 g samples were spiked with surrogate standards (13C12-BDE 209, BDE 77, 181, and 205) and then Soxhlet-extracted with acetone/hexane (v/v = 1:1) for 24 h. Activated copper granules were added to the extraction flasks to remove element sulfur. The extract solution was concentrated to 1 mL with a rotary evaporator and then purified by a multilayer column filled with 8 cm neutral silica, 8 cm acidified silica, and 2 cm anhydrous sodium sulfate from bottom to top. The column was eluted with 30 mL hexane/dichloromethane (v/v = 1:1). The eluate was concentrated to near dryness under a gentle nitrogen flow and reconstituted in 200 µL of isooctane. Internal standards (BDE 118 and 128, 4-Fluoro-BDE 67, 3-Fluoro-BDE 153) were spiked before instrumental analysis.

2.3. Instrumental analysis

Tri- to hepta-BDE congeners (28, 47, 66, 100, 99, 154, 153 and 183) were quantified by an Agilent 6890 gas chromatography (GC) coupled with 5975 mass spectrometer (MS) with electron capture negative ionization (ECNI) in the selective ion-monitoring (SIM) mode and separated by a DB-XLB (30 m × 0.25 mm × 0.25 µm, J&W Scientific). The initial temperature was set at 110 ºC (held for 1 min), and ramped at 8 ºC/min to 180 ºC (held for 1 min), then 2 ºC/min to 240 ºC (held for 5 min), subsequently 2 ºC/min to 280 ºC (held for 15 min), finally 10 ºC/min to 310 ºC (held for 10 min). Octa- to deca-BDE congeners (202, 197, 203, 196, 208, 207, 206, and 209), DBDPE and BTBPE were analyzed by a Shimadzu model 2010 GC coupled with a model QP2010 MS (Shimadzu, Japan) using ECNI in the SIM mode. A DB-5HT (15 m× 0.25 mm × 0.10 µm, J&W Scientific) was used for separation. The temperature of the DB-5HT was held at 110 ºC for 1 min, then increased to 200 ºC at a rate of 20 ºC/min (held for 5 min), finally raised to 310 ºC at a rate of 10 ºC/min (held for 15 min). 1 µL of the sample was injected in the pulsed splitless mode. The monitored and quantitative ions were as follows: m/z 492.7 and 494.7 for 13C12-BDE 209, m/z 486.7 and 488.7 for BDE 209, m/z 79 and 81 for other compounds.

An aliquot of the sediment sample was treated with 10% hydrochloric acid solution to remove inorganic carbon, washed with purified water to remove chlorine ion, and dried to constant weight at 60 oC before the determination of total organic carbon (TOC) by a CHN-O Rapid Elemental Analyzer (Heraus, Germany). Acetanilide used as the external standard was analyzed with each batch of 20 samples to ensure the relative standard deviation less than 5%.

2.4. Quality assurance and quality control

One procedural blank was performed in each batch of the sample analysis. Trace amounts of BDE 153 were detected in the procedural blanks (n = 6) and subtracted from the samples. Recoveries of BFRs were evaluated by spiking known amounts of 11 PBDE congeners (BDE 28, 47, 66, 85, 100, 99, 138, 153, 154, 183 and 209) and DBDPE in matrices and solutions, which were passed through the entire analytical procedure. The average recoveries of BFRs in the spiked blanks (n = 3) and matrices (n = 3) ranged from 98% to 116% and 70% to 130%,

Fig. 1. Map of mangrove sampling sites in the Pearl River Estuary, South China.

respectively. The relative standard deviations (RSD) of all target compounds in the spiked blanks and matrices were less than 16%. The average recoveries of surrogate standards in all samples (n = 61) were as follows: 89 ± 12% for 13C12-BDE 209, 96 ± 10% for BDE 77 (mean ± RSD), 107 ± 15% for BDE 181, and 108 ± 16% for BDE 205. Reported concentrations were not corrected by surrogate recoveries. For BDE 153, method detection limit (MDL) was defined as three times the standard deviation of the procedural blanks. For the undetected compounds in the procedural blanks, MDLs were set as a signal of five times the noise level. Based on the mean dw of sediment samples, MDLs for PBDEs ranged from 0.00073 to 0.022 ng g^{-1} dw. MDLs for DBDPE and BTBPE were 0.056 and 0.0063 ng g-1 dw, respectively.

2.5. Data analysis

All concentration data were presented on a dw basis. Statistical analysis was performed with SPSS 16.0 (SPSS Inc., Illinois, USA). The level of significance was acceptable at $p < 0.05$. One-way ANOVA accompanied by the Least Significant Difference (LSD) test was used to determine the spatial variations in BFR concentrations among mangrove wetlands in the PRE of South China. Simple linear correlation analysis was used to investigate the relationship between BDE 209 and DBDPE concentrations in mangrove sediments of the PRE.

3. Results and discussion

3.1. Levels and spatial distribution of BFRs

Concentrations of ∑PBDEs, DBDPE and BTBPE in surface sediments of mangrove wetlands in the PRE are summarized in Table 1. PBDEs were found in all sediment samples with concentrations ranging from 1.25 to 206 ng g-1 dw. The median concentrations of ∑PBDEs in the present study were higher than those of the same congeners measured in mangrove sediments from Hong Kong of China, Sundarban of India, and Sungei Buloh and Sungei Khatib Bongsu of Singapore (Table S1, Supplementary Material). These results suggested that mangrove sediments of the PRE have been heavily polluted by PBDEs.

The relatively higher PBDE concentrations in mangrove sediments of the PRE can be attributed to burgeoning electronic/electrical manufacturing industries and intensive e-waste recycling activities in the PRD region. It is estimated that 20-50 million metric tons of e-wastes are disposed in the PRD region each year, accounting for about 70% of the global production (Zhang et al., 2012). Remarkable PBDE contamination was found in sediments (3.7-5,708 ng g-1 dw), fish (8-1,300 ng g-1 lipid weight, lw) and birds (35-15,000 ng g-1 lw) from the PRD region (Zhang et al., 2009; Zhang et al., 2010; Sun et al., 2012; Chen et al., 2013). Great attention should be paid to higher levels of PBDEs in mangrove ecosystems of the PRE because of their adverse effect on mangrove plant species (Wang et al., 2014), even on biota.

DBDPE was detected in all mangrove sediments with concentrations ranging from 0.364 to 34.9 ng g-1 dw (Table 1), which were significantly lower than levels of PBDEs (1.25-206 ng g-1 dw). The highest mean DBDPE concentrations were measured in mangrove sediments from Shenzhen (21.6 ng g-1g dw), followed by Zhuhai (9.53 ng g-1 dw) and Guangzhou (4.03 ng g-1 dw). This is the first study to report the occurrence of DBDPE in mangrove ecosystems. Chen et al. (2013) reported that DBDPE was detected in surface sediments of the PRE close to the three mangrove wetlands with a mean concentration of 10.2 ng g-1 dw, which is similar to the results obtained in the present study (11.5 ng g-1 dw). DBDPE, an additive BFRs, is used as a replacement for the structurally similar Deca-BDE. The production volume of commercial DBDPE in China was estimated to be 12000 metric tons in 2006 and increases at a rate of 80% per year (Sun et al., 2014). It was found that DBDPE levels increased rapidly and BDE 209 concentrations decreased in sediment cores collected from the Dongjiang River (the upstream of the PRE), which runs across the major manufacturing base for electronic/electrical products of the PRD (Zhang et al., 2009). The elevated DBDPE levels in sediments of the PRE should be of great concern because of its potential adverse effect on mangrove ecosystems.

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Table 1

Concentrations of BFRs (ng g-1 dw) in surface mangrove sediments of the Pearl River Estuary, South China

			ΣPBDEs[a]			DBDPE			BTBPE		
Locations	N	TOC (mg g-1)	range	median	mean	range	median	mean	range	median	mean
Guangzhou	9	17.7 ± 4.77	1.25-36.3	12.0	14.1	0.364-10.4	4.56	4.03	ndb-0.0453	0.0133	0.0172
Zhuhai	12	28.7 ± 3.26	7.37-70.2	16.3	24.1	2.71-19.6	9.20	9.53	0.021-0.118	0.0369	0.0435
Shenzhen	9	43.5 ± 2.72	82.3-206	142	143	14.3-34.9	20.9	21.6	0.183-0.794	0.241	0.297

a Sum of BDE 28, 47, 66, 100, 99, 154, 153, 183, 202, 197, 203, 196, 208, 207, 206, and 209.
b Not detected.

Linear correlation analysis revealed that DBDPE concentrations were significantly correlated with BDE 209 concentrations in sediments among these three mangrove wetlands in the PRE (Fig. 2), suggesting that these two BFRs have similar emission sources and/or environmental behaviors due to their similarities in chemical structures. Similar relationships between DBDPE and BDE 209 concentrations were also found in non-mangrove sediments of the PRE (He et al., 2012; Chen et al., 2013).

BTBPE were quantified in 93% of the mangrove sediment samples with concentrations ranging from not detected (nd) to 0.794 ng g-1 dw (Table 1), which were two to three orders of magnitude lower than those of PBDEs and DBDPE. BTBPE concentrations in mangrove sediments increased in the order of Guangzhou (0.0172 ng g-1 dw) < Zhuhai (0.0435 ng g-1 dw) < Shenzhen (0.297 ng g-1 dw). Until now, no BTBPE data on mangrove

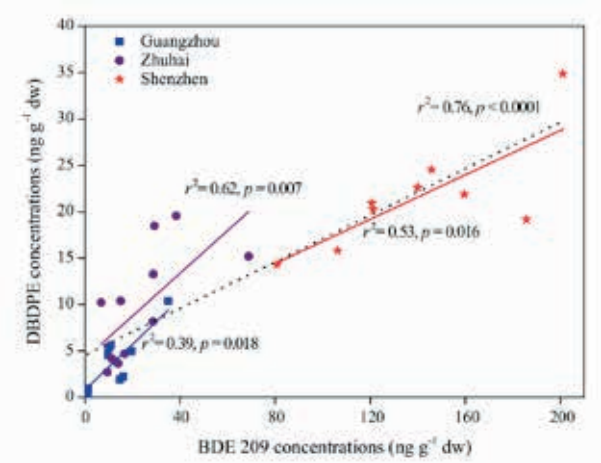

Fig. 2. Correlation of BDE 209 concentrations plotted against DBDPE concentrations in mangrove sediments of the Pearl River Estuary.

ecosystems is available. The BTBPE levels in the present study were comparable to those in sediments of the PRE (0.04-0.53 ng g-1 dw), but higher than those in sediments of the San Francisco Estuary in the US (<0.03-0.06 ng g-1 dw) (Klosterhaus et al., 2012), the Dalian coastal area in China (below detection limits) (Wang et al., 2011), and the Western Scheldt Estuary in the Netherlands (nd-0.31 ng g-1 dw) (López et al., 2011).

Significant differences for the concentrations of PBDEs, DBDPE and BTBPE were observed in sediments among the three mangrove wetlands in the PRE, South China ($p < 0.0001$). Generally, concentrations of PBDEs, DBDPE and BTBPE in mangrove sediments prevailed in the same orders of Shenzhen > Zhuhai > Guangzhou (Table 1). Concentrations of PBDEs, DBDPE and BTBPE in mangrove sediments from Shenzhen were significantly higher than those from Zhuhai and Guangzhou ($p < 0.001$). Shenzhen is one of the most economically developed cities of China, characterized by high population densities (a population of 6500 km-2) and high levels of industrialization. In addition, Futian mangrove wetland, the only reserve located in the center of metropolis in China (Shenzhen), has received a great amount of industrial and municipal wastewater discharged directly (Tam et al., 2006). Thus, the highest BFRs concentrations were expectedly found in sediments of Futian mangrove wetland from Shenzhen. Relatively higher PBDE levels (mean, 80.3 ng g-1 dw) were also reported in sediments of Mai Po mangrove ecosystem from Hong Kong (Zhu et al., 2014), which is adjacent to Futian mangrove ecosystem from Shenzhen. Concentrations of ∑PBDEs, DBDPE and BTBPE were significantly higher in mangrove sediments from Zhuhai compared to Guangzhou ($p < 0.01$). Qi'ao Island mangrove wetland is located close to the urban district of Zhuhai (a population of 623 km-2) and suffered from discharge of untreated domestic sewage from the island, while Tantou mangrove wetlands is located at Nansha District of Guangzhou with low population densities (a population of 240 km-2) and low levels of industrialization. Furthermore, the geographic distribution of BFRs in the mangrove sediments of the PRE was in correspondence with the TOC contents (Table 1) and significant correlations were found between the concentrations of BFRs and the TOC contents in the mangrove sediments of the PRE (Fig. S1), indicating that TOC is also an important factor determining the levels of BFRs. Therefore, higher levels of BFRs in the mangrove sediments from Shenzhen might be partly ascribed to high contents of TOC.

3.2. Compositional profiles of BFRs

BFRs in mangrove sediments of the PRE were dominated by PBDEs, with mean contributions of 86.6%, 70.6% and 75.6% for Shenzhen, Zhuhai and Guangzhou, respectively (Fig. 3). DBDPE also contributed relatively larger proportions to the total BFRs (13.2-29.2% on average). The contribution of BTBPE to total BFRs (0.07-0.16%) in mangrove sediments was significantly lower than those of PBDEs and DBDPE ($p < 0.001$). This distribution pattern was similar to the previous

study reported for sediments of the PRE (Chen et al., 2013). The main reason for this observation might be ascribed to the extensive use of Deca-BDE and DBDPE in the PRD region.

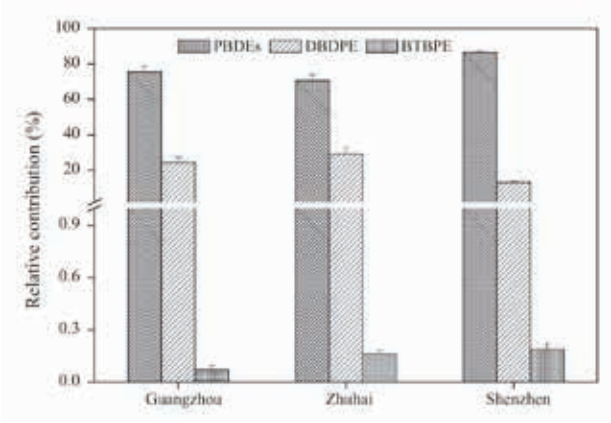

Fig. 3. Composition of BFRs in mangrove sediments of the Pearl River Estuary.

Mangrove sediments of the PRE have the similar PBDE congener distribution patterns (Fig. 4). BDE 209 was the most abundant congener and constituted more than 90% of the total PBDEs with the exception of two samples from Guangzhou (83.1% and 83.7%). The average contributions of BDE 209 to the total PBDEs in mangrove sediments from Shenzhen, Zhuhai and Guangzhou were 98.0%, 96.3% and 91.6%, respectively. A small difference in congener profiles among the three sampling sites was the contribution of BDE 208, 206, 47, 207, 197 and 28. Compared to Shenzhen and Zhuhai, mangrove sediments from Guangzhou contained relatively higher abundances of these congeners. The ratios of BDE 47/(BDE 47+ BDE 99) in mangrove sediments from Guangzhou, Zhuhai and Shenzhen were 0.693 ± 0.065, 0.602 ± 0.006 and 0.618 ± 0.022, respectively, which were significantly higher than those in the Penta-BDE technical mixtures (0.444 in DE-71 and 0.500 in Bromkal 70-5DE). These results may be partly ascribed to the easy degradation of BDE 99 due to the presence of meta-substituted bromine.

3.3. Temporal trends of BFRs

The temporal trends of ∑PBDEs, DBDPE and BTBPE in mangrove sediment cores of the PRE are shown in Fig. 5. PBDE concentrations in the sediment cores were in the range of 0.0901-67.7, 0.208-75.7 and 1.82-212 ng g^{-1} dw for Guangzhou, Zhuhai and Shenzhen, respectively. Concentrations of ∑PBDEs in the mangrove sediment cores from Guangzhou and Shenzhen increased gradually from the bottom to the top layers. ∑PBDEs levels in the upper segments of sediment cores from Guangzhou (5.40-67.6 ng g-1 dw at 0-8 cm) and Shenzhen (71.4-212 ng g^{-1} dw at 0-24 cm) were significantly higher than those in the deeper segments (0.0901-0.724 ng g-1 dw at 8-44 cm and 1.82-3.14 ng g-1 dw at 24-36 cm). The vertical distributions of ∑PBDEs in Guangzhou and Shenzhen were similar to those observed in sediment cores of Mai Po mangrove ecosystem from Hong Kong (Qiu et al., 2010; Zhu et al., 2014). These results suggested that Deca-BDE commercial mixtures are still largely used in the PRD region. On the other hand, concentrations of ∑PBDEs in the sediment cores from Zhuhai increased rapidly from the segment 40-44 cm to the segment 16-20 cm, followed by a decrease to the surface. This pattern may be partly attributed to the large use of DBDPE at this sampling area, further certified by the sharp decline of PBDEs in coincidence with the increase of DBDPE at the segments 0-20 cm (Fig. 5).

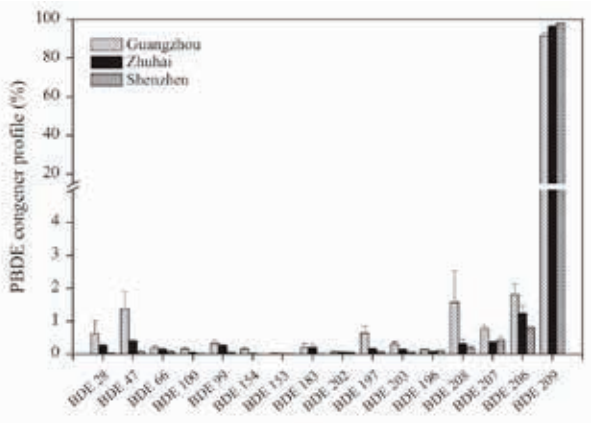

Fig. 4. PBDE congener profiles in mangrove sediments of the Pearl River Estuary.

DBDPE was detected in 94% of the segments in the sediment cores with concentrations ranging from nd-34.9 ng g-1 dw. The sediment core collected from Shenzhen (0.374-34.9 ng g^{-1} dw) contained higher DBDPE concentrations than those from Guangzhou (nd-5.97 ng g^{-1} dw) and Zhuhai (0.263-18.5 ng g-1 dw), indicating that mangrove wetland from Shenzhen may be close to the input source. A rapid increase of DBDPE concentrations started in the segment 12-16 cm for Guangzhou, 20-24 cm for Zhuhai and Shenzhen. These results suggested that DBDPE, as a replacement of Deca-BDE mixtures, is widely used in the PRD region. An increased trend of DBDPE levels was also found in the upper layers of sediment cores from the Dongjiang River located in the upstream of the PRE (Zhang et al., 2009).

BTBPE was detected in 90% of the segments in the sediment cores with concentrations ranging from nd-0.384 ng g-1 dw. Concentrations of BTBPE in sediment cores collected from Guangzhou, Zhuhai and Shenzhen generally showed an increasing trend from the bottom to the top sediment layers. The relatively higher concentrations of BTBPE (0.114 ng g^{-1} dw) at the segment 28-32 cm in sediment core collected from Zhuhai might be an accidental input of BTBPE.

3.4. Mass inventory of BFRs

To assess the potential of sediments as the receptor for BFRs in mangrove wetlands, the mass inventories of BFRs were calculated by the following equation described by Mai et al. (2005).

$$\text{Inventory} = \sum C_i \rho_b d_i \qquad (1)$$

where Ci (ng g^{-1} dw) is the concentration of contaminants in mangrove sediment layer i, ρb (g cm^{-3}) is the dry mass bulk density of the sediment segment i, and di (cm) is the thickness of the sediment i.

Inventory of BFRs in sediments represents the total integrated mass of BFRs per unit area from the bottom to the surface sediments. The inventories of ∑PBDEs, DBDPE and BTBPE in the mangrove sediment cores of the PRE ranged from 334-4206, 40.4-471 and 0.428-8.68 ng cm^{-2}, with mean values of 1962, 245, and 4.10 ng cm^{-2}, respectively (Table 2). The inventories of BFRs at three mangrove sampling sites were in the same orders of Shenzhen > Zhuhai > Guangzhou, showing the dependence on the proximity to the urban areas. Using the average inventories, the total burden of PBDEs, DBDPE and BTBPE in the mangrove sediments of the PRE, with an area of 15.7 km2 for mangrove ecosystems, would be 308, 38.1 and 0.644 kg, respectively. Data on the mass inventories of BFRs in sediments are extremely limited. The mass inventories of PBDEs in the present study were much higher than those in the sediments of Great Lakes (3.3-143 ng cm-2) (Song et al., 2004, 2005a,b; Zhu and Hites, 2005), twelve Chinese lakes (1.0-463 ng cm^{-2}) (Wu et al., 2012), and Manila Bay of the Philippines and the upper Gulf of Thailand (11-34 ng cm^{-2}) (Kwan et al., 2014). PBDE inventories in two sediments cores of the PRE were reported in the range of 279-569 ng cm-2 (Chen et al., 2007), which were lower than those in the present study. It is clear that PBDE inventories in the mangrove sediments of the PRE were at the high end of the worldwide figures.

Table 2
Mass inventories of BFRs in mangrove sediment cores of the Pearl River Estuary.

Locations	Inventory (ng cm-2)		
	PBDEs	DBDPE	BTBPE
Guangzhou	334	40	0.43
Zhuhai	1347	224	3.2
Shenzhen	4206	471	8.7

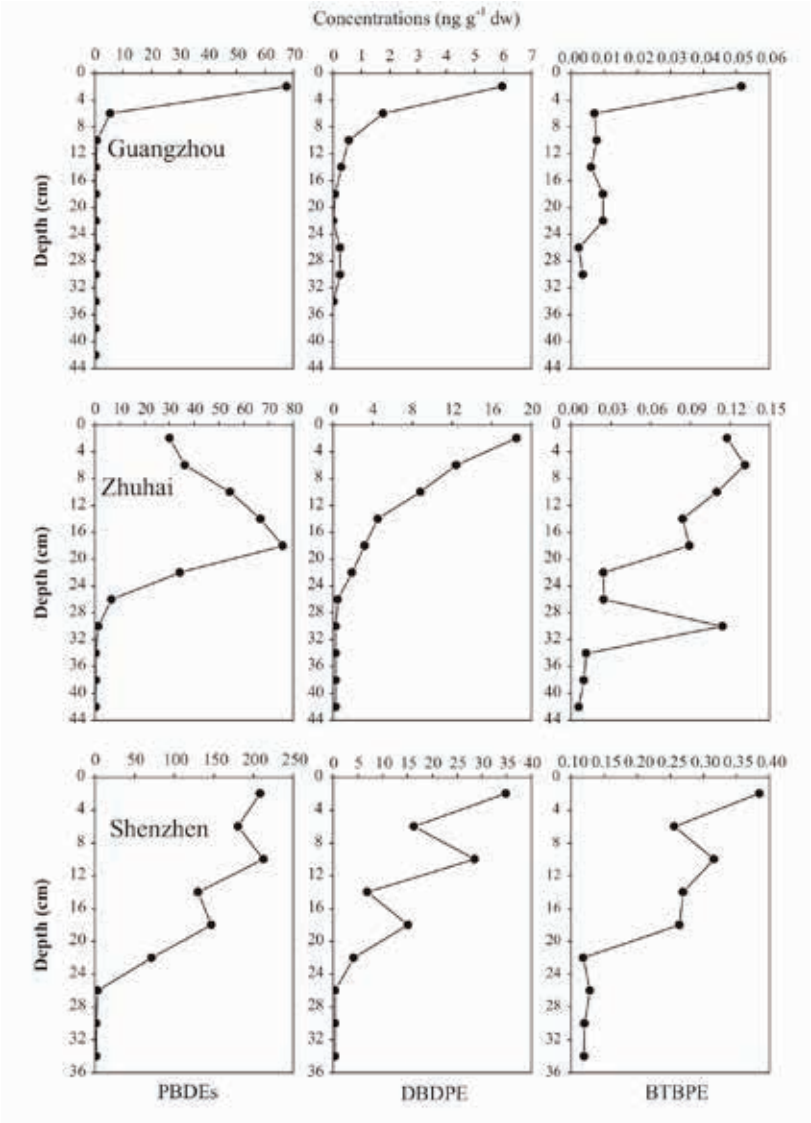

Fig. 5. Temporal trends of RPBDEs, DBDPE and BTBPE in mangrove sediments cores of the Pearl River Estuary

4. Conclusions

The results of this study showed the occurrence of PBDEs, DBDPE and BTBPE in mangrove sediments of the PRE, South China. Relatively higher concentrations of ∑PBDEs, DBDPE and BTBPE were observed in mangrove sediments of the PRE, which can be attributed to burgeoning electronic/electrical manufacturing industries and intensive e-waste recycling activities in the PRD region. Significant difference for BFR concentrations were found among the three mangrove sampling sites from the PRE, increased in the order of Guangzhou < Zhuhai < Shenzhen. BDE 209 was the most abundant congener and constituted more than 90% of the total PBDEs, indicating the large use of Deca-BDE commercial mixtures in the PRD region. Concentrations of ∑PBDEs, DBDPE and BTBPE in mangrove sediment cores of the PRE generally showed an increasing trend from the bottom to the top layers. The mass inventories of BFRs showed mangrove sediments are important

reservoirs for BFRs. More studies should be conducted to investigate the potential effects of BFRs on biota from mangrove ecosystems in the PRE.

Acknowledgments

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城鄉生活圈規劃與建設方法芻議

劉雲剛，侯璐璐
（中山大學地理科學與規劃學院，廣東省城市化與地理環境空間模擬重點實驗室，廣州 510275）

1 生活圈的基本理念

生活圈，指根據居民實際生活所涉及的區域，通過中心地區和周邊區域之間、根據自我發展意志、締結協議形成的圈域。生活圈內各項建設活動，特別是基于生活需求的公共服務的建設運營，是以地區合作為基礎、以多方共贏為目標進行的。生活圈內部公共資源及公共服務的獲得，除了自助方式以外，還包括互助、共助、公助，從政府、社會層面對市場的服務功能進行補充。

1.1 自助

是公共服務獲取機制裏最基礎、最廣泛的方式，指通過自己工作或養老金來支撐自己的生活。自助內容的選擇較多受個人經濟能力和服務需求迫切性共同影響，是市場經濟下選擇最優性價比的結果。自助是城鄉居民獲取服務最核心的實現方式，因而自助模式主導下，資源集聚、經濟發達的城市化地區的服務水平明顯優于鄉村地區。生活圈的建設首先是基于對區域社會經濟發展的宏觀認識，通過城鄉自助模式的比較，深入瞭解地區不同收入階層、不同服務需求的差异，促進公民自助有效開展的同時明確各個區域有待完善的服務內容。

1.2 互助

指的是非正式的相互扶助，是東方傳統生活方式下形成的一種特殊的服務獲取方式，其實現基礎是强烈的社區歸屬感和鄰裏認同，如中國俗語中“遠親不如近鄰”折射的就是通過互助獲得服務的方式。近鄰互助、社區團體及志願者的幫助是互助的主要形式，其服務形式靈活多樣，且最貼近居民的實際生活需求，是自助的有效補充。日本社會中豐富多樣的社會團體及社區組織，成為實現互助的最佳保障，通過發揮規模龐大、參與人數眾多的第三方組織、社會群體的力量，能够實現生活圈內各項服務需求的定期掃描、供給、反饋、修正，有助于提升圈域中落後地區公共服務的數量和質量。

1.3 共助

指的是制度化的相互扶助，由政府主導開展、針對公共服務提出的制度性服務內容及要求，以實現對社會群體迫切需要、但無力負擔的服務的保障。通過頂層制度設計和政策實施，促進基本公共服務的全覆蓋，保障社會各地區、各階層能够均等地享受教育、醫療、住房、就業、社會保障等基本公共服務。

1.4 公助

指的是自助、互助、共助無法涉及的，經濟收入、生活水平、家庭狀況等貧困程度低于設定標準的情況下，給予一定生活保障、技能培訓的社會福利制度。公助不僅僅是經濟方面的援助，更加注重技能、社會交往能力等方面的幫助，通過政府和社會力量的參與，幫助貧困人口及家庭、弱勢群體等擺脱其所處的社會經濟困境，公助的水平是生活圈基本公共服務保障能力的重要體現，是社會自我發展能力的直觀反映。

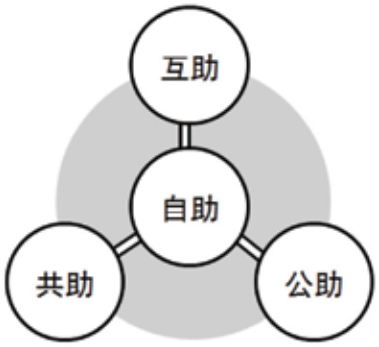

圖 1 基于生活圈的公共服務供給方式示意圖

1.5 小結

生活圈的基本理念是基于對市場環境下公共服務獲取模式的完善，在個體層面為保障生居民的生活需求提供多樣化的途徑，充分發揮個體、市場、社會、政府在公共服務供給方面各自的優勢，形成“自助”、“互助”、“共助”、“公助”相結合的服務模式（圖1），這種服務供給的

複合模式是生活圈中公共服務供給的路徑，在打造生活圈的過程中逐步形成並完善，以確保能够為生活圈內所有居民的生活需求提供穩定持續的保障。

2 生活圈的形成方式

生活圈發展的目標包括兩個層面，一是實現個體層面生活服務的有效提供，二是實現區域層面整個圈域的協調發展。基于此，要求生活圈內必須建設多元有效的合作發展模式，實現圈內各項資源的合理分配和利用。每個生活圈都以"集約化和網絡化"為指導思想，根據生活圈域範圍內全部居民生活所需要的服務功能進行資源的集中整備，確保能為圈域內所有居民點（村莊）提供必要的生活功能、保障農林水產業的振興及自然環境的保護，通過相互分工合作，實現區域一體化發展的活力[1]。

2.1 確定生活圈域

生活圈的範圍，指的是居民生活行動所及的區域，不僅包括流域等自然環境條件、旅游觀光資源，還包括人們對區域的歸屬感等。因而，在城市化地區，一墻之隔的小區也有可能不屬同一生活圈；在廣大鄉村地區，生活圈不僅僅是自己生活的村莊，也包括與自身日常生活、社會活動等密切相關的周邊村莊。因而生活圈範圍的確定，除了考慮空間距離因素外，還應充分考慮圈域內居民的日常生活行為習慣、經濟聯繫、社會聯繫等方面因素，以認同感和歸屬感為參考，明確能够有效開展密切合作、實現區域協同發展的地區。在日本，最初生活圈的確定通過經濟水平較高、社會發展較快的中心地區（一般是中心市）發布生活圈域公告，由周邊地區（一般是市町村）根據自身情況、與中心市的關係決定是否參與生活圈計劃，經過多輪座談協商確定生活圈域的範圍，制定生活圈規劃並逐步實施。生活圈形成後，通過定期開展的生活圈域調查，監督核實生活圈內各項合作的開展情況，根據反饋可進一步修訂生活圈覆蓋範圍。

2.2 制定生活圈協議

生活圈協議，指為了周邊地區（基層村）的全體居民能够安心定居，通過相互合作形成的圈域中，作為中心地區（中心村）需要擔負提供並保障必要的生活功能，以書面形式記錄規定要做的事的文件的編制及公布。

生活圈協議的主體包括中心地區和周邊地區。生活圈在城市化地區的表現形式為"中心地區—周邊地區"，在鄉村地區的表現形式為"中心村—基層村"。中心地區（中心村）具備以下特徵：(1)區位條件上，具有便捷的區際交通條件，地理位置適中；(2)經濟實力相對較强，居民生活較為富裕；(3)規模效益方面，具有一定的服務設施基礎及規模，能為周邊地區（村莊）提供最基本的生產、生活服務；(4)與中心鎮區或社區中心具有良好的聯繫，能够對周邊地區的生產生活發展產生一定影響的地區。周邊地區（基層村），指區位條件較差、交通不便捷、經濟發展相對落後，以農業生產和鄉村生活為主的地區。中心地區和周邊地區開展合作的前提是合作共贏，各個地區間的關係不是單純地給予或索取，而是通過相互協作促進彼此的健康發展。如經濟發達的中心地區向周邊地區提供其需要的各種基本公共服務，周邊地區作為中心地區的生態屏障，提供休閑游憩功能，提高生活圈內不同生活片區整體生活水平；中心地區為周邊地區提供農產品對外交流平臺，周邊地區則保障中心地區的農產品供給，從而實現區域產業經濟的協調發展。

通過對生活圈域內各種資源條件的統一評價，提出生活圈發展的共同目標，保障日常生活必要的功能，包括教育、醫療、文化、福利等公共服務，交通、采購、消費（商業）、就業等日常性的生活行為，傳承作為地域綜合體的歷史、傳統、文化，促進經濟發展與生態環境相協調、生活質量與生活服務同提升，塑造健康發展、富于活力的地區生活圈形象。主要內容包括以下四個方面：(1)生活服務功能的確保。包括通過區域內的合作交流實現生活服務功能

在區域內高效配置；根據地區地勢、氣候、歷史、文化、生活方式的差异，綜合考慮各圈域能够提供何種水平的公共服務。(2)地域資源的活用。地區資源指包括自然、土地、農林水產物，加工產物，人工公共物品，技術，歷史、文化、傳統等，地區自身具備的資源以及地區產生的資源。(3)實現最高效的公共空間的重組。支撐生活圈的社會資本運營模式，形成合理的公共空間布局與公共服務設施空間分布。(4)地區人材的培養和活用。生活圈內部組織建設、人才建設，强化地區歸屬感，為生活圈的長期穩定發展提供保障。

2.3 分工協作

生活圈中的中心地區和周邊地區的分工合作，主要指中心地區為生活圈提供大規模商業、娛樂功能，核心的醫療功能，與生活相關的各類服務功能、行政職能及民間職能，即替代鄉村地區不具備的城市服務職能，不僅應為中心地區的居民服務，同樣應為周邊地區提供同樣功能的靈活使用，實現集約化服務功能的溢出。通過充實發展功能，支撐包括周邊地區在內的整個區域的生活，提高區域魅力，提高生活圈整體管理水平。另一方面，周邊地區要充分發揮其在生活圈中對環境、氣候、食品生產、歷史文化傳承等方面的重要作用。通過分工協作，實現城鄉生產、生活、生態的和諧發展。

生活圈內的分工協作是以服務生活為導向、以區域共同的長期發展願景為目標，包括但不限于以下方面的內容：(1)醫療。醫院和診所的分工合作，邊遠地區醫療的提供、醫生的培養和派遣，醫療信息共享、醫療合作體系。(2)福利。面向老年人的上門服務，整合片區內主要福利設施，向周邊地區或基層村提供服務利用支援，形成醫療、介護、育兒服務等的合作網絡。(3)教育。整合教育資源，解決中小學校的區域外就學問題，實現學校教育資源等共享活用，加强初高中學校設置在生活圈層面的聯繫，保證生活圈及流動人口能够享受便捷高質量的教育資源環境[3]。(4)土地利用。合理利用規模效應和地區特性，推進服務功能的集約化，促進農業、二三產業的部署在生活圈內部的統籌[4]。(5)產業振興。促進本地加工產品的品牌化，振興農林水產業，培養本地自主產業，吸引先進企業入駐，促進旅游資源的開發，通過振興工商產業，提供更多就業機會[5]。(6)地域公共交通。促進生活圈內部交往活動的發展，建立生活圈內提高便利性的公共交通綫路，提高生活圈內各節點的交通可達性。加强生活圈內公路等交通基礎設施的建設，從生產便利和服務生活的角度出發建設生活圈內的鄉村幹道、支路。(7)地產地消。保障地區食品安全，促進生活圈內部的循環經濟發展，打造生產者、直營店、消費者之間的直接聯繫，通過直銷系統推廣本地產品，通過合作平臺建設進一步推動生活圈內有效合作。(8)居民交流。推進生活圈內部居民的相互交流，體驗生活圈內部的差异性和多樣化，加强不同村莊之間的相互理解與合作[6]。(9)合作化的人才培養機制。人才培養能力較强的地區與其他地區指定合作政策，保障人才長期培養，如定期開展培訓、生活圈內部工作人員的交流等。

3 基于生活圈的城鄉一體化建設

從日本近半個世紀的生活圈建設實踐中，可以發現其不同于西方市場主導的模式，而是更多地轉向傳統文化營造的民間力量和社會力量，政府以第三方姿態，以生活圈規劃的方式為各種社會團體實現其在公共服務領域的最佳效益提供平臺。生活圈理念從實踐角度提出了如何在公共產品的供給上，以“自助、互助、共助、公助”相結合的方式，以生活圈建設為依托，實現國家、市場、社會之間的合作，形成最為有效的城鄉基本公共服務的管理模式。三方力量在生活圈建設的不同方面相互協作、實現城鄉管治中的動態發展。

3.1 生活單元形成

市場導向下公共服務更多地集中于資本集中、經濟發達的地區。行政力量介入的目標是協調這種經濟發展不均衡帶來的公共資源分布的不均衡。但是，政府主導公共產品的供給模式中，基本單元是行政管轄的範圍。行政邊界的劃定和調整受多種因素的影響，往往與居民的

實際生活空間形態相去甚遠。因而傳統的自上而下的管治中，公共服務的供給很難與居民實際需求相契合，容易造成兩方面的負面效應，一是部分地區公共產品供給過剩，如鄉村退化、空心村地區，二是部分地區公共產品的供給不足，如城鄉結合地區、流動人口集中地區。而社會力量由于缺少統一管理經營平臺，很難形成制度化、規範化、長期化的作用效果，對公共服務的補充效益較難達到最佳狀態。

生活圈作為一個以居民的實際生活需求為基礎劃定的單元，提供了一種新的多元合作平臺，一方面打破了行政邊界桎梏下公共資源難以在區域內有效配置的困局，另一方面為市場環境提供了約束範圍，同時將社會力量引入規範化的運作方式，在生活圈的基礎單元內形成市場、行政、社會的最佳合作方式。

基于生活圈形成的生活單元包括兩種合作形態：(1)中心型生活圈(圖2a)。這類生活圈中，中心地區(中心村)不論在經濟發展，還是社會發展水平方面都明顯好于周邊，具備服務中心村及周邊基層村的多數公共職能，這種類型的生活圈，周邊地區(基層村)通過參與協議制定享受中心村提供的各方面服務。(2)互補型生活圈(圖2b)，這類生活圈中不存在經濟發展特別突出、社會服務特別完善的中心地區，而是存在若干某一方面發展相對較好的地區，因而這一類生活圈中服務功能的提供是通過幾個中心地區的互補實現的。這種生活圈往往可以有兩個或多個中心地區(中心村)，周邊地區(基層村)可根據實際聯繫情況確定合作村莊，其所屬中心村不具備的服務職能可由互補中心村提供。

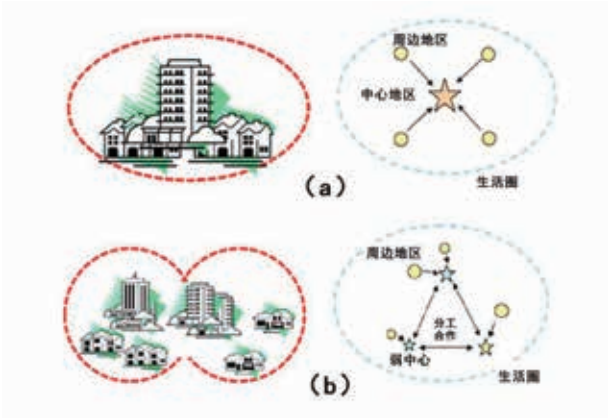

圖 2生活單元合作形態示意圖

3.2 聯合協議

生活圈協議的制定，是充分發揮行政力量、市場力量、社會力量各自優勢的重要方式。基于政府管理角度開展的規劃建設，其周期長、程序複雜、內容繁冗，不適合在中小尺度開展，如近來各地區大力推行村莊規劃，其編制審批完成一般需要兩三年，而這期間村莊發展可能已經出現了巨大變化。公共服務在基層的配置也是如此，缺少定期反饋修正的服務配給模式大都是低效的。生活圈聯合協議的制定有效彌補了上述機制帶來的問題。聯合協議是對外公開、定時修正的，因而作為其發布主體的行政部門直對居民負責，大大提高服務型政府的工作效率；將公共服務的投資建設權力部分交由市場，對各類資源的利用效也將大大提高；同時作為社會力量參與的生活圈建設的居民及社會組織，統一經營運作利于其對地區發展的促進作用。通過聯合協議的制定，明確了城鄉社會管治中三方的工作內容與合作方式，將現有相互獨立的公共產品供給主體有機結合起來，從而實現城鄉社會管治模式的轉變。

3.3 生活圈體系

生活圈提出的在城鄉基層開展公共服務有效配置的思路，並不是以單個生活圈建設為目的，而是以形成由小到大、從基層到宏觀的生活圈體系為目標[7]。根據日本生活圈建設經驗，不同資源在不同等級的生活圈配置中有效性不

同。政府部門在宏觀層面的資源配置，能够有效針對城鄉公共服務不均衡的狀況，促進公共服務在大範圍內的均等化配置；市場部門在中觀層面促進各類資源的高效組合最具優勢，能够助力集約化發展；而在城鄉社區及以下的微觀層面中，社會力量的多元性、時效性則為政府和市場供給的不足提供了最為有效的補充。因而，構建尺度適合、權責明確的生活圈體系，是生活圈建設有序進行的重要保障。根據上述不同尺度下管治主體的作用特點，將生活圈劃分為三級體系"城鄉生活圈—擴展生活圈—基礎生活圈"。城鄉生活圈以行政邊界為參考，促進行政權力在轄區內公共服務均等化方面的最大作用；擴展生活圈以經濟發展的組合效益為依據，最大限度實現企業引導下的資源流動；基礎生活圈以個人生活為核心，探索自助、互助、公助、公助的不同合作模式，實現生活範圍內各類需求的基本滿足(圖3)。

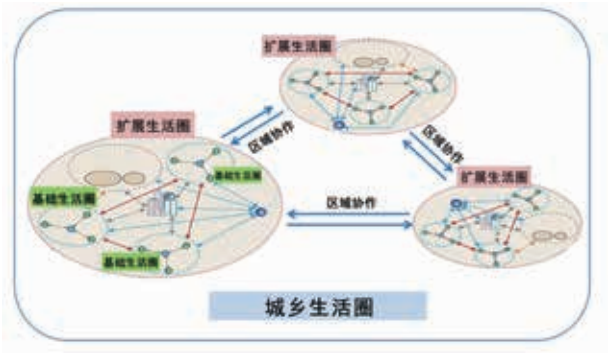

圖 3 生活圈體系示意圖

4 生活圈規劃實踐—廣東鶴山市的案例

鶴山是我國著名的僑鄉之一，現為廣東省江門代管縣級市，1993年撤縣設市。2014年土地面積1108平方千米，常住人口50萬人，人均GDP4.6萬元。2004年後鶴山經濟發展進入瓶頸期，人口吸引力下降、土地開發停滯、產城分離、城鄉發展差距持續拉大等問題開始顯現。公共服務以自上而下配置方式為主，尤其是鄉村地區，居住分散，公共服務不足，管治失控較為嚴重[8]，亟需新的城鄉管治思路，對公共資源進行有效配置，促進資源利用效益最大化。因此本文擬以鶴山為例，對基于生活圈的城鄉管治方式進行分析嘗試。

4.1 鶴山市的生活圈/管治單元類型

4.1.1 基礎生活圈。是保障居民最基本生活需求的單元，根據城鄉不同的空間布局和行為方式特點，可以'劃分為城區基礎生活圈和鄉村基礎生活圈。

城區基礎生活圈，一般半徑為500-800m，根據居民步行出行時間調整。城區基礎生活圈內，以人均指標衡量公共服務水平，低于平均水平或缺少某些服務的，考慮通過相鄰基礎生活圈之間的合作，實現圈域內公共服務共享。

鄉村基礎生活圈，一般半徑不超過1km，根據居民為獲取基本服務付出的時間距離調整，一般以自然村為單位。在鄉村生活圈中，需考慮村莊與周邊村莊之間的聯繫，開展突破行政邊界的服務合作。

4.1.2 擴展生活圈。是若干基礎生活圈通過協議形成的圈域。一般以經濟發展好、公服建設集中的城鄉居民點作為中心，實現圈內的公共服務資源統籌安排。鄉村地區的擴展生活圈通常由中心村和經濟社會聯繫密切的若干周邊村莊構成，城區的擴展生活圈通常由核心社區和若干周邊社區構成。擴展生活圈內需要進行交通網絡優化和教育、醫療、社會福利等資源的共享。

鶴山作為一個南方沿海地區工農業混雜地區，其擴展生活圈大致可分為三類：(1)產業主導類。圈域內一般有多個不同類型的產業園區，生產性服務設施較為齊備，生產空間與生活空間存在分離現象，生活服務配套不完備。此類地區需要從完善最基本的生活服務功能出發，與相鄰生活圈制定區域合作協議，建立跨區域的生活圈服務體系；(2)生活主導類。生活服務設施相對齊全，生活質量普遍較高，工業園區內職住空間分離的現象比較明顯。此類地區需要通過建設生活圈之間的交通網絡，加强與產業

園、鄉村地區的聯繫，實現服務功能效益的最大化。(3)鄉村類。鄉村或生態農業園區，需要進行“中心村—基層村”的體系建設，實現各項資源的最優配置。同時需要加强與鄰近生活主導單元圈域的交流，補充服務功能不足。

4.1.3城鄉生活圈。以行政邊界為依據、由若干擴展生活圈組合形成的圈域，是通過行政力量管理區域公共資源的高級單元，通過城鄉一體化的公共服務建設，在宏觀層面保障公共資源的均等化布局。

4.2 鶴山市的生活圈管治體系

根據上述生活圈層劃分方法，結合鶴山市空間現狀，可將鶴山市生活圈管治體系劃分為上述三個層次，即基礎生活圈、擴展生活圈和城鄉生活圈。

在基礎生活圈內，積極開展資源的整合管理。對內部公共服務進行評價，明確優勢與不足，提出需要完善補充、能够與其他生活圈開展合作的基本方案。

在擴展生活圈內，根據各圈域內生產、生活、生態的實際情況，重點開展教育、醫療、產業、社會、交通等方面的聯合協議服務。

在城鄉生活圈內，針對各個生活片區的實際生活服務供給情況，提出不同服務功能的統籌布局方案。

圖4鶴山生活圈體系示意圖

4.3 基于生活圈的規劃建設方法

通過鶴山生活圈形成自下而上的分工體系，緩解之前相對難航的管治主體間矛盾。管治强調政府、市場、社會所代表的三方力量以協調方式達到管理的最佳效益。西方社會中，市場在資源配置中占絕對主導地位，政府通過行政手段填補市場不能涉及的服務範圍，市民社會提供的資源作為補充(圖5 a)。在我國的公共資源分配中，自上而下的行政力量占主導地位，同一尺度下的市場力量與社會力量較難在協商中體現其話語權和決定權，因而，以個主體平等協商展開的管治往往難以產生期待的效果。

基于生活圈的城鄉規劃建設方法中，政府、市場、社會是三個不同層次圈域的主體，最大限度減少協商過程中產生矛盾的可能性，同時在各層次實現其力量的最大效益。城鄉生活圈層面，政府作為資源分配主體，通過行政力量統籌管理，保障宏觀區域範圍內的公平性，同時對下一層次的市場行為進行限制和監管。擴展生活圈層面，市場作為資源管理的主要手段，追求中觀層面的資源配給的效率性。基礎生活圈層面，市民社會培育的民間力量和社會團體作為服務居民基本生活的主體，與市場相互協作，實現對個體最優服務的供給。政府從全面控制公共服務配置，轉變為通過規範化制度監督市場行為、管理並服務社會組織，三者從爭奪話語權的對立狀態轉變為權責相輔的合作狀態。

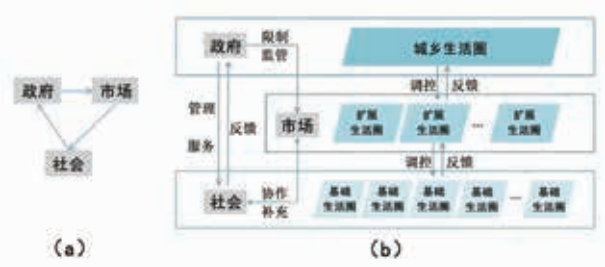

圖 5 基于生活圈的管治理念示意圖

5 討論與結論

生活圈作為一個來自日本的理念，其研究和實踐開展都有其背景和時代要求。這裏僅以鶴山市為例，從前期研究的角度為開展城鄉管治提供一些思考。在當前中國的城鄉協調狀況下，實踐生活圈理念應有選擇、有條件的開展，充分考慮：(1)圈域協作的可能性，這與地區間的行政轄區變遷、歷史文化淵源、經濟發展模式密切相關；(2)市民社會的發育程度。鶴山較多民間團體的發育是其生活圈理念推行的有力保證；(3)政府簡政放權的作為能力。在中微觀層面將管理權力一定程度歸還市場和社會，對政府的管理能力是一種考驗。

生活圈理念是通過區域協作，引導政府力量、市場資本和社會力量形成共治格局，因此有自助、互助、公助、共助相結合的管治模式，實現資本、政府、社會在公共產品供給上的相互補充，促進公共資源在宏觀層面的均衡布局。目前，我國正面臨社會經濟的全面轉型，城鄉社會建設中公共資源有限、分配不均衡等問題極為突出，優質高效的公共服務的供給必須充分發動社會資本和公眾力量，生活圈的理念及實踐經驗為我國城鄉管治的改革提供了發展思路。當然，生活圈的形成不應是強制的，而是以相互信任、通力協作為基礎。

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“智慧－綠色－韌性”：城市基建規劃的理念與策略

莊宏曦工程師
奧雅納工程顧問管理咨詢 | 政策與可持續發展主任

1. 引言

為了解決現代城市所面臨的各種問題，世界各地的城市不論在理論或實踐的層面上都發展了不同的城市發展理念，例如綠色城市(Green City)、生態城市(Eco City)及低碳城市(Low Carbon City)等。隨著資訊科技滲透至生活工作的各層面，數位城市(Digital City)、泛在城市(Ubiquitous City)、精明城市／智慧城市(Smart/Intelligent City)、感知城市(Sensing City)及韌性城市(Resilient City)等已成為近年城市發展的主要趨勢。但是現有的各種城市發展的理念都過於單一，現代城市難以依賴單一概念性的規劃作為全面及長遠規劃發展的基礎。

2. “智慧－綠色－韌性”作為城市及基建規劃的內涵

密集的城市發展令災害對財產、民生及城市基礎設施造成的破壞更為嚴重，而城市系統的相互關聯會導致影響的衝擊更加嚴重。城市的生命線–即各基礎設施及系統網路－之間有相互關聯的關係，各種風險要素因基礎設施的相互依賴，形成相互交織的災害鏈。基礎設施一旦中斷，會環環相扣地影響系統中的其它設施，加劇各種災害的程度。關鍵基礎設施系統一旦發生故障，例如交通系統遭受損壞，將對整個城市的功能產生骨牌效應，影響糧食提供、運輸及救災等方面，嚴重影響各經濟及日常活動。

奧雅納(Arup)於2014年提出的“智慧－綠色－韌性”(Smart-Green-Resilient)的綜合規劃理念，並透過該理念對城市及基建規劃提出相應的對策。其內涵概述如下：

- 智慧：城市利用資訊及通信科技，啟動智慧增長。城市收集、整合及運用日常生活、交通、經濟及城市基礎設施等相關資料，通過資料處理平臺發放綜合資訊，促進更有效率的資源運用，以大資料開發新的服務以提供便利的經商環境，協助政府及機構為市民提供服務，提高生活品質。
- 綠色：規劃融合自然的生態系統，把綠色技術運用在能源、水、廢物、交通等基礎建設之中，建設一種自然與發展和諧共生的綠色發展模式。在區域、社區及建築物層面通過不同措施達到全方位減排及推動低碳生活。
- 韌性：面對自然及人為的不確定因素，強化現有基礎建設、增強風險管理及促進政府各部門的協調與合作，建構經濟及社會韌性，加強城市抵禦自然或人為危機的承受力，在危機發生的時候能夠靈活動員或調配資源迅速應變及復原。

城市的規劃應該在一個系統化及整體的構架下，綜合考慮“智慧－綠色－韌性”對城市各範疇規劃的影響及作出相應的對策。城市規劃應評估城市現有各系統的關聯性、複雜性及脆弱性，通過利用創新的信息技術及管理，策略性地調動資源以提升基建系統協調統籌及綜合管理的能力，並提升城市迅速適應社會、經濟或物理衝擊及回復正常秩序的能力。

3. “智慧－綠色－韌性” — 城市層面之重點策略

3.1 整合規劃基建設施實現協同效應

不同類大型市政基礎設施整合規劃可以實現集約用地、優化佈局、降低交通運輸和管道基建成本、實現產業公生並提高空間品質的目的。例如在規劃中，可結合生質能源與熱、電、冷三聯供系統(CCHP)以建立區域能源供應系統的策略，並研究基建設施整合規劃、系統級聯以及產業共生的可能性，並將汙水處理系統和有機廢棄物消化系統整合規劃在資源中心內。這樣的整合規劃節約了土地，並且因地制宜地優化了資源的利用效率。

3.2 設置中央資訊控制中心及預留用地予資訊技術和通信基礎設施

要成為發展資訊技術的理想地點，城市需要充裕的土地、強大的資訊技術基礎設施、可靠的電力供應、資訊的自由流通及對資料隱私的充分保護。城市應設置中央資訊控制中心，並預留用地予資訊技術和通信基礎設施，包括通信井與管道、通信線纜、感測器、通信交換和連接網路及資料中心。其中，資料中心和雲計算樞紐設施同時更可為技術及服務供應商提供商機，並大大降低技術及服務的成本，令城市更具競爭力。

3.3 建立開放資料平臺，以資料便利規劃

要充分利用龐大而複雜的資料，城市要有資料開放標準(Open Protocol)及資料分享平臺(Data Sharing Platform)。制定資料開放標準，以便於公私營機構以可讀的格式公開資料，提高城市的資料流通量。不同的資料分析工具可以解構城市運作及用戶行為，這不但有助政府決策、有利企業開發創新服務產品及便利市民，而且能幫助規劃師在規劃用地時針對不同的場景設計實驗及模型，令其規劃更能切合居民。

3.4 應用資訊科技催化行為改變

要讓資訊科技全方位發揮效用，資訊科技應該被運用於城市的能源、交通、水資源、廢物等系統，以實現智慧基建。智慧感測器從基建系統收集資料，即時的資料通過網路傳輸，經處理後成為有用資訊。例如，資料分析可以預計災害，讓城市提早預防；即使災害發生，智慧系統讓城市有效調配資源並儘快復原。即時的資料更有助改變市民的行為習慣，實現更綠色環保的生活方式。

3.5 以人為本—考慮未來最終用戶的需求

一個城市規劃的計畫將直接影響城市未來幾代人，故此城市規劃不應該只局限於滿足直接的客戶的需求，而需要考慮包括客戶在內的更廣泛的未來用戶的需求。城市開發的最終受益者應該是社區民眾，營造這樣的氛圍將使得實現可持續發展的目標更為有效、經濟甚至有趣。將規劃的好處通過公共參與活動告知未來的居民和經營者不僅能促進公眾意識的形成，並且能夠讓民眾參與監督可持續發展規劃的執行情況，並共同分擔責任。

3.6 打造智慧城市群，增強地區／區域協同效應

通信技術的快速發展使智慧城市間的集群發展成為可能。雲計算、移動應用程式、電信及大資料分析等為城市發展帶來新機遇，城市之間可以在區域的智慧基礎設施和服務、通信技術及人才交流上建立合作夥伴關係，推動新興產業的發展，提升區域競爭力。

4 小結

本文提出了“智慧－綠色－韌性”規劃概念，作為更前瞻性的城市及基建規劃對策。要落實此規劃概念，我們建議了幾點城市層面之策略貫徹“智慧－綠色－韌性”的理念於整體規劃之中。隨著城市系統相互關聯越來越深，各城市必需因應自身的情況，推動各層次及領域的“智慧－綠色－韌性”規劃，以實現城市長遠的可持續發展。

Decomposition Analysis in Decoupling Transport Output from Carbon Emissions in Guangdong Province, China

Yalan Zhao [1,2], Yaoqiu Kuang [1] and Ningsheng Huang [1]

1 Sustainability Development Research Center, Chinese Academy of Sciences, Guangzhou 510640, Guangdong, China

2 University of Chinese Academic of Sciences, Yuquan Road, Beijing 100049, China

1. Introduction

In response to climate change, it is indispensable to reduce greenhouse gas emissions. Plentiful carbon emission (CE) research studies suggest developing the tertiary industry to improve gross energy efficiency in order to reduce CE [1]. As a particular sector of tertiary industry, transport has produced the second largest amount (23%) CE among all sectors around the world in 2013 according to the World Energy Outlook 2015 report of IEA, which cannot be ignored. Nowadays, many developed countries have reached their peak of CE. Things are quite difficult in developing countries, especially in big countries like China, where economic development is still the most urgent task, so she still has surging energy consumption demands and carbon emissions [3,4]. At the same time, she has attached great importance to environment conservation and formulated abundant policies to contribute her share to mitigation of climate change. China has made a promise to achieve its CE peak within 2030 at the U.S.-China Joint Announcement on Climate Change in November 2014. So she must work vigorously in promoting energy efficiency in the transport sector.

There is a rich collection of literature focusing on the environmental aspects of fuel consumption in transportation and changes in energy intensity of transport [5-7] as well as the links between transportation and other socioeconomic activities [8,9]. Chung et al. [10] discussed the energy efficiency of transport in China from 2003 to 2009, and found that although all areas has continuously improved their energy efficiency since 2005, the policies in the transport sector mainly focused on the economic development instead of the energy efficiency. Zhou et al. [2] found a similar improving trend, and Eastern China plays the best in reducing CO2 emissions due to the transport infrastructure being heavily concentrated and organized in spatial clusters. Tirumalachetty et al. [11] found that the urbanization process has a significant impact on TCE.

Several analytic methods have been used in recent researches, decomposition analysis is one of the most effective and widely applied tools for investigating the mechanisms influencing energy consumption and its environmental side effects. Considering its advantages of factor reversibility and residual elimination, we chose Logarithmic Mean Divisia Index (LMDI) method to decompose factors affecting energy-related TCE. LMDI method can explain the influences of the variation but not the stock, so it has better explanatory ability in developing countries where economy and policy change rapidly [12], and fits this paper well. The decoupling index could illustrate environmental pressure of economic growth, which reflects the whole responsiveness of environmental pressure to economic output change (including stock and variation) during a certain period of time [13]. After combining these two methods, the stock explanatory limitation of LMDI method could be eliminated [14]. To examine the total emissions of the whole transport sector, we learned from studies on industry structure and utilize more general factors such as energy structure, energy intensity, economic output and population, instead of freight [15] or passenger transportation[16].

Besides, this paper innovatively added industrial structure and tertiary industrial structure to emphasize the relationship and interaction between transport and tertiary industry.

2. Materials and Methods

2.1. Data Sources and Processing

The energy consumption data of transport is quoted from *China Energy Statistical Yearbook (1996-2013)*. The unit of final energy consumption of transport is "10^4 tons of standard coal". Other socioeconomic data come from the *Statistical Yearbook of Guangdong Province (2006-2013)*. The unit of TO, SO and GDP is "10^8 Chinese Yuan" (CNY), and the population is measured by "10^4 persons". In addition, to eliminate the effect of price changes, we converted the economic output values from current price to the constant price in the year of 1995.

2.2. Decomposition Model of Energy-Related Carbon Emission

To analyze TCE's change in Guangdong, we decompose the TCE as an extended Kaya identity [17]:

$$CE = \sum_i CE_i = \sum_i \frac{CE_i}{E_i} \cdot \frac{E_i}{E} \cdot \frac{E}{TO} \cdot \frac{TO}{SO} \cdot \frac{SO}{GDP} \cdot \frac{GDP}{P} \cdot P = \sum_i f_i \cdot ES_i \cdot I \cdot TS \cdot IS \cdot G \cdot P \quad (1)$$

where CE is TCE in China, i is the type of energy, E is the final energy consumption in transport. TO is transport output, SO is the service industry (tertiary industry) output, GDP is the gross domestic product in Guangdong, and P is total permanent resident population. CE can be decomposed into seven effects: (a) the CE coefficient of certain energy (denoted by f effect); (b) the energy structure (ES effect); (c) the energy intensity, measured by the changes in the amount of energy consumption per unit of transport output (I effect); (d) the transport status, or the tertiary industrial structure, estimated by the proportion of transport output in service industry (TS effect); (e) the industrial structure, the proportion of service industry output in total GDP of Guangdong Province (IS effect); (f) GDPPC in Guangdong (G effect); (g) the Population scale (P effect).

In LMDI additive analysis, the changes of CE were formulated as follows [18]:

$$\Delta CE = CE^t - CE^0 = \Delta CE_f + \Delta CE_{ES} + \Delta CE_I + \Delta CE_{TS} + \Delta CE_{IS} + \Delta CE_G + \Delta CE_P \quad (2)$$

$$\Delta CE_f = \sum_i w_i \cdot \ln (f_i^t / f_i^0)$$

$$\Delta CE_{ES} = \sum_i w_i \cdot \ln (ES_i^t / ES_i^0)$$

$$\Delta CE_I = \sum_i w_i \cdot \ln (I^t / I^0)$$

$$\Delta CE_{TS} = \sum_i w_i \cdot \ln (TS^t / TS^0)$$

$$\Delta CE_{IS} = \sum_i w_i \cdot \ln (IS^t / IS^t)$$

$$\Delta CE_G = \sum_i w_i \cdot \ln (G^t / G^0)$$

$$\Delta CE_P = \sum_i w_i \cdot \ln (P^t / P^0) \quad (3)$$

where $w_i = (CE_i^t - CE_i^0)/(\ln CE_i^t - \ln CE_i^0)$, which means the weight of different types of energy. The index variable "t" and "0" refer to the examined year and the first year. In this paper, we mainly considered two analysis perspectives named initial effects and alternate effects. The former uses year 1995 as the baseline while the later compares the examined year against the preceding year. ΔCE refers to the change of carbon emissions between the base year 0 and a target year t. The effects, ΔCE_f, ΔCE_{ES}, ΔCE_I, ΔCE_{TS}, ΔCE_{IS}, ΔCEG and ΔCE_P were calculated every year in the period 1995-2012.

As the systematic monitoring of CE in China needs more of a wait-and-see approach, here the CE coefficients are fixed obtained from recent research, thus was treated as constant. Therefore ΔCEf = 0. The Equation (3) can be simplified as:

$$\Delta CE = CE^t - CE^0 = \Delta CE_{ES} + \Delta CE_I + \Delta CE_{TS} + \Delta CE_{IS} + \Delta CE_G + \Delta CE_P \quad (4)$$

2.3 Decoupling Index

LMDI method could not explain the influence factors of the emissions stock, which could be analyzed by the decoupling index. Therefore, in this paper the decomposition technique was associated with the decoupling elasticity to analyze the relationship between transport growth and carbon emissions.

The elasticity index εt was calculated with Equation (5), and following Tapio's criterion [9]:

$$\varepsilon^t = \frac{\partial P \nabla TO}{\partial P \nabla CE} = \frac{\nabla TO \backslash TO_t}{\nabla CE \backslash CE_t} \quad (5)$$

Combining Equations (4) and (5), the elastic value was decomposed into six factors:

$$\varepsilon_t = \frac{\Delta CE_{ES}/CE^t}{\Delta TO/TO^t} + \frac{\Delta CE_I/CE^t}{\Delta TO/TO^t} + \frac{\Delta CE_{TS}/CE^t}{\Delta TO/TO^t} + \frac{\Delta CE_{IS}/CE^t}{\Delta TO/TO^t} + \frac{\Delta CE_G/CE^t}{\Delta TO/TO^t} + \frac{\Delta CE_P/CE^t}{\Delta TO/TO^t} = \varepsilon_{ES} + \varepsilon_I + \varepsilon_{TS} + \varepsilon_{IS} + \varepsilon_G + \varepsilon_P \quad (6)$$

where εt is the decoupling elasticity value of total energy-related carbon emission and economic growth. εES, εI, εTS, εIS, εG, εP are the decoupling elasticity values of energy structure, energy intensity, transport status, industrial structure, GDP per capita and population size, respectively.

3. Results

3.1.Analysis on Carbon Emissions

3.1.1.Macro-Level: Energy-Related Carbon Emissions of Transport

The estimated results (Figure 1) showed that the energy-related TCE in Guangdong rose from 3.35 million tons in 1995 to 16.42 million tons in 2012, an increase of nearly five-fold in 18 years. With the exception of a temporary recession in 1997 due to the Asian financial crises, Guangdong's TCE kept increasing. The annual growth rate was fluctuating from -4.22% to 29.12% and then kept below 10.22% since 2006. The average annual growth rate of CE in transport, tertiary industry, secondary industry and province-wide total were 10.03%, 9.57%, 7.64% and 7.53% respectively.

The growth rate of CE in transport was even higher than that of both total CE and each main industry within Guangdong. TCE accounted for 86% of the tertiary industry CE on average, and its remarkably consistent annual increase rate stabilized tertiary industry CE at a relatively high level. Therefore, if improving the proportion of the tertiary industry in GDP is a good way to reduce TCE, optimization of energy efficiency and structure in the transport sector must happen simultaneously.

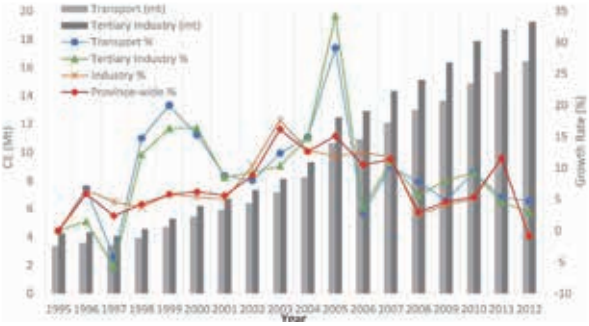


Figure 1. Carbon emissions and its average annual growth rate in Guangdong Province during 1995-2012.

3.1.2. Micro-Level: Energy Intensity and Structure

Generally speaking, the improvement of energy efficiency is the primary driving force behind TCE reduction. With the development and renovation of technology, energy intensity of the secondary industry were continually descending (see Figure 2), which directly led to declining intensity of all industries' total energy consumption. Intensity of primary and tertiary industries were kept below 0.6 and showed a bit of decrease after 2005. Transport, on the other side, has an energy intensity higher than that of all other sectors. Energy intensity of transport was continuing rising from 1995 to 2005, stayed steady for five years in 2005-2011, and fell sharply in 2011-2012. It indicated that related policies and techniques worked after 2005, and played better after 2010.

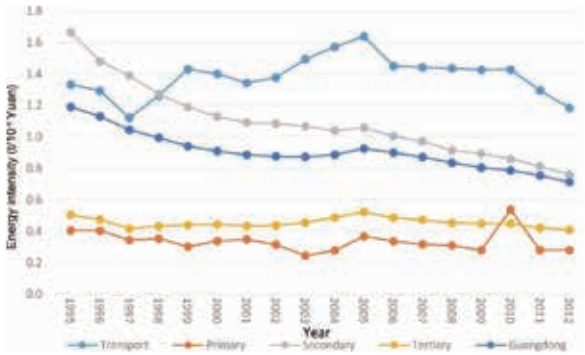


Figure 2. Energy intensity of transport sector, three main industries and the grand total in Guangdong.

Over the period of 1995-2012, fossil energies, especially diesel contributed the most to TCE. Among the fossil energies, TCE from raw coal, coke and crude oil were at a low level and showed a significant reduction since 1998. The increment of CE from fuel oil and kerosene were on an intermediate level. Fuel-oil-related CE fluctuated but showed a generally rising trend during the studied period. Gasoline and diesel contributed the most to TCE. Figure 3 shows that the proportion of gasoline-related TCE was kept near one third of the total steadily. However, the proportion of diesel-related TCE increased from one third to half within the studied years. As for clean energy, it had a rapid growth but still accounts for a very small slice among all energy types.

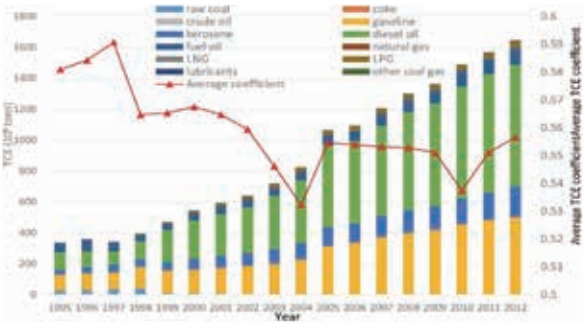


Figure 3. Average TCE coefficient and TCE structure of different energy types.

Therefore, from a micro-perspective, petroleum products took a dominant role in transport sector within Guangdong's CE structure during the studied years. This was not good for TCE reduction. However, clean energies have many unique advantages and will in no doubt be of growing importance in future.

3.2. Analysis on Decoupling Indexes

3.2.1. Decoupling Elasticity

Decoupling elasticity values and states of the transport sector in Guangdong can be seen in Table 1. In the first three years, the elasticity state of accumulated decoupling changed from WD (weak decoupling) to SD (strong decoupling) and back to WD. The outlier appeared in 1997 was due to the Asian Financial Crisis, in which TCE did decrease while transport output was still slowly growing in Guangdong. Ever since 1999, it remained at a state of EC, in which the elasticity value was within a relatively narrow band from 0.96 to 1.12. There was a weak declining trend after 2005, where elasticity value dropped from 1.09 to 0.96. From a yearly perspective, the elasticity values demonstrated much more volatile fluctuations, ranging from -0.53 to 3.07 before entering a relatively steady decline from 1.91 in 2003 to 0.38 in 2012, corresponding to a decoupling state change from SD to expansive negative decoupling (END) and eventually to WD. With the exception of the outlier in 1997, the smallest yearly decoupling value showed in 2006, in which the yearly decoupling state turned from END to WD, with no END state seen afterwards. It highlights that transport growth was accompanied by a substantial increase in environmental pressure, though a significant improvement was seen after 2006. The decoupling state in two different perspectives from 2010 to 2012 varies, indicating relatively alleviated environmental pressure compared to preceding years, (a state of WD in alternate years) which is still remarkable (a state of EC in initial years) compared to1995.

Table 1. The elasticity values and states of CE and output of transport sector in Guangdong.

Time Series	Initial						Alternate					
	0	t	ΔCE	ΔTO	ε	State	0	t	ΔCE	ΔTO	ε	State
1 year	1995	1996	22.33	40.78	0.73	WD	1995	1996	22.33	40.78	0.73	WD
	1995	1997	7.21	84.08	0.13	SD	1996	1997	-15.11	43.29	-0.53	SD
	1995	1998	57.70	118.70	0.68	WD	1997	1998	50.49	34.62	2.05	END
	1995	1999	136.22	150.34	1.12	EC	1998	1999	78.52	31.64	3.07	END
	1995	2000	208.24	251.02	1.04	EC	1999	2000	72.02	100.68	0.90	EC
	1995	2001	255.81	346.48	0.97	EC	2000	2001	47.57	95.46	0.66	WD
	1995	2002	303.11	395.61	0.99	EC	2001	2002	47.30	49.13	1.25	END
	1995	2003	381.79	446.21	1.05	EC	2002	2003	78.68	50.60	1.91	END
	1995	2004	488.63	552.53	1.06	EC	2003	2004	106.85	106.32	1.20	END
	1995	2005	728.57	737.63	1.09	EC	2004	2005	239.93	185.10	1.43	END
	1995	2006	758.62	928.46	1.02	EC	2005	2006	30.05	190.83	0.20	WD
	1995	2007	870.37	1078.23	1.01	EC	2006	2007	111.76	149.77	0.94	EC
	1995	2008	964.36	1205.18	1.01	EC	2007	2008	93.99	126.95	0.93	EC
	1995	2009	1026.85	1300.76	1.00	EC	2008	2009	62.50	95.58	0.83	EC
	1995	2010	1153.78	1508.19	1.00	EC	2009	2010	126.93	207.43	0.80	WD
	1995	2011	1232.51	1763.50	0.98	EC	2010	2011	78.72	255.31	0.43	WD
	1995	2012	1306.94	2059.24	0.96	EC	2011	2012	74.43	295.74	0.38	WD
6 years	1995	2000	208.24	251.02	1.04	EC	1995	2000	208.24	251.02	1.04	EC
	1995	2006	758.62	928.46	1.02	EC	2001	2006	502.81	581.98	1.08	EC
	1995	2012	1306.94	2059.24	0.96	EC	2007	2012	436.56	981.01	0.68	WD
5-year plan	1995	2000	208.24	251.02	1.04	EC	1995	2000	208.24	251.02	1.04	EC
	1995	2005	728.57	737.63	1.09	EC	2000	2005	520.32	486.60	1.18	EC
	1995	2010	1153.78	1508.19	1.00	EC	2005	2010	425.22	770.56	0.72	WD
	1995	2012	1306.94	2059.24	0.96	EC	2010	2012	153.15	551.05	0.42	WD

The name of state: "WD" = Weak decoupling; "SD" = Strong decoupling; "EC" = Expansive coupling; "END" = Expansive negative decoupling. Which could also be seen in the Abbreviations.

The different trends in initial and alternate perspectives could be seen with a time scale of 6 years. If we set the time interval as 6 years, the studied period could be divided into three portions. When compared to 1995 (initial view) the decoupling elasticity remained in the state of EC, while the values went down from 1.04 to 0.96, and declined a little faster in the later period. In the alternate view, the elasticity values grew from 1.04 to 1.08 at first and then dropped sharply to 0.68, and the elastic state advanced from EC to WD. Similar trends can be demonstrated if we set the time interval as five years, which corresponds to Guangdong's five-year development plans. The end points in both views were the finish years of the plans, and the start point in initial view was 1995 and in alternate perspective was the last finish year of the plans. In this time scale, the elasticity values rose a bit in the former two plans, and then fell in the latter two plans. The decrease was much sharper in the alternate views and the elastic state turned from EC to WD in the 11th Five-Year Plan (2006-2010).

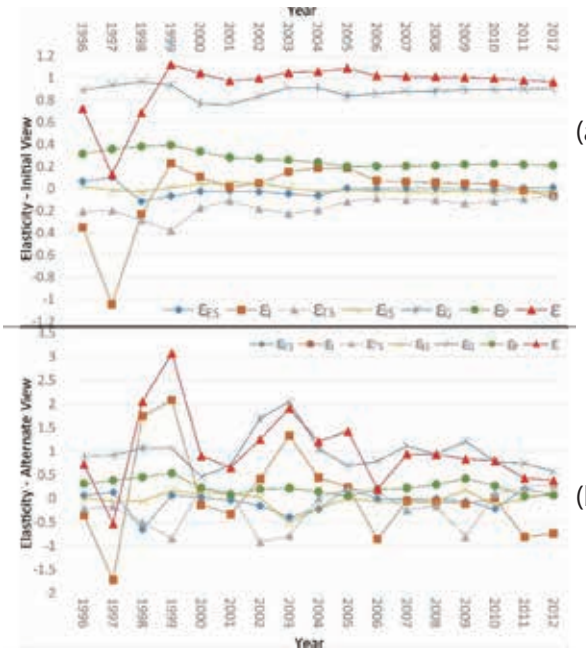
Overall, the initial decoupling state of transport in Guangdong was EC, and the alternate view displayed an improvement from EC to WD. In both views elasticity state improvement after 2005 can be seen by all three time scales, though they showed the quite different trends. By associating them, we could tell more details of the decoupling path in Guangdong. In this case, an investigation in multiple views of time seems quite necessary.

3.2.2. Decomposition Analysis

Contribution of six factors to elasticity are seen in Figure 4 and Table 2. Due to the outlier in 1997, this paper estimated the average values of each factors excluding the year of 1997, named "ME97" in the table.

In the initial views, over the studied years, TS was the only effect that always played an inhibiting role in the increase of TCE, which accounted for average of -17.00%. Though TS's absolute contribution to TCE reduction was rising from 0.06 million to 0.93 million tons, it was still dwarfed by the effect of G and P. G and P factors had the largest negative effects on elasticity, which on average occupied 90.96% and 27.24% of the overall elasticity respectively. The ES, I and IS factors had alternations of positive and negative effects and accounted for average -1.96%, 1.30% and -0.54% respectively. Among them, I factor experienced the most volatile changes, but saw further optimization since 2004. ES and IS factors had the smallest proportions and variations. In 2012, the ES, G and P effects were positive; I, TS and IS effects were negative. The initial effects of G and P factors had the largest impact which accounted for 93.71% and 21.88%. The proportion of ES, I, TS and IS factors were much lower at 0.96%, -7.19%, -7.09% and -2.28%, respectively.

Much larger variations can be seen in the decomposition results from an alternate years' perspective. G and P effects remained stably positive and contributed the most from 1995 to 2012, accounting for on average 120.78% and 26.73% of the elasticity value respectively. The G effect was definitely in the majority. There was large fluctuation of I effect, whose contribution to TCE fluctuated from -1.48 million to 0.55 million tons, and the average proportion was -40.66%, while ES, TS and IS effects waved much tenderly and occupied -1.86%, -3.36% and -1.63%, respectively. Although there were four factors had inhibited function according to ME97, only I factor maintained negative in 2012.



(a)

(b)

Figure 4. Decoupling elasticity and its components of transport in Guangdong, in initial (a) and alternate view (b).

Table 2. The proportion of decomposition factors of the elasticity value.

Year	Initial						Alternate					
	ε_{FS}	ε_{I}	ε_{TS}	ε_{IS}	ε_{G}	ε_{P}	ε_{FS}	ε_{I}	ε_{TS}	ε_{IS}	ε_{G}	ε_{P}
	%	%	%	%	%	%	%	%	%	%	%	%
1996	8.98	-48.45	-28.97	2.95	122.40	43.09	8.98	-48.45	-28.97	2.95	122.40	43.09
1997	78.24	-808.70	-152.86	-13.13	721.21	275.25	-25.00	327.04	32.27	10.88	-173.57	-71.64
1998	-16.74	-34.42	-41.63	-4.07	141.04	55.82	-31.72	84.93	-24.59	-2.69	51.95	22.13
1999	-6.01	20.20	-33.82	1.01	83.54	35.08	2.17	67.70	-27.40	5.43	34.63	17.48
2000	-2.53	9.97	-16.66	3.85	73.43	31.94	2.78	-14.69	24.69	10.90	51.03	25.29
2001	-2.50	1.26	-11.23	5.65	78.00	28.82	-5.74	-49.95	20.39	16.41	107.52	11.38
2002	-2.75	4.92	-18.37	5.11	83.99	27.10	-12.22	32.85	-73.60	1.47	135.39	16.11
2003	-4.55	14.45	-21.62	0.36	86.77	24.60	-20.58	69.60	-41.35	-26.74	107.38	11.69
2004	-6.04	17.65	-18.19	-2.33	86.37	22.54	-18.67	36.49	0.54	-17.67	87.51	11.79
2005	0.20	17.13	-10.83	-1.72	77.04	18.19	16.12	16.61	15.20	0.41	48.12	3.54
2006	0.00	6.87	-8.83	-2.39	84.40	19.95	-3.54	-438.52	78.01	-31.41	399.91	95.55
2007	0.13	5.93	-10.03	-2.93	86.75	20.16	-1.49	-5.80	-25.61	-9.89	119.33	23.47
2008	0.30	5.24	-10.39	-3.16	87.27	20.73	-0.71	-6.74	-17.10	-7.26	100.06	31.75
2009	0.18	4.62	-13.20	-2.33	89.05	21.67	-6.94	-13.79	-97.87	22.42	145.77	50.41
2010	-1.41	4.42	-11.63	-3.28	89.54	22.37	-27.89	1.05	14.00	-18.86	97.76	33.93
2011	0.44	-1.79	-9.48	-3.14	92.00	21.98	48.48	-188.31	54.12	0.94	172.90	11.87
2012	0.96	-7.19	-7.09	-2.28	93.71	21.88	21.21	-193.52	75.80	27.49	150.83	18.19
ME97 1	-1.96	1.30	-17.00	-0.54	90.96	27.24	-1.86	-40.66	-3.36	-1.63	120.78	26.73

[1] "ME97" means the mean values of each factors excluding the year of 1997.

4. Conclusions

In conclusion, the level of decoupling elasticity between transport output and TCE was relatively low over the studied years in Guangdong, especially when compared with the year of 1995, in which case it remained as EC. 2005 was a turning point, at which environmental protection was highly emphasized and the alternate elasticity started optimizing towards WD. By covering nearly a decade before and after the turning point, the effectiveness and significance of policy change was clearly shown. However, as seen from the data, the time frame used in the analysis can cause significant drift of decoupling values, therefore it should be selected with caution. It's also important to note that decoupling is relative, and in Guangdong's case the selection of reference year can lead to fundamental change of the decoupling analysis' result. With 1995 being the reference, we see a continuous trend of EC, while with 2005 there is a transition to WD.

Within all the factors taken into consideration, structure of tertiary industry displays highest level of impact on EC decoupling. Unfortunately, transport has a dominate role in tertiary industry. It's accounted for the majority of output, energy consumption and intensity in tertiary industry. Thus we should pay more attention to the carbon emission reduction in transport sector by more targeted researches, policies and real actions.

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作者簡介

趙亞蘭，女(1992-)，江西南昌人。中國科學院廣州地球化學研究所博士生，研究方向為人口、資源與環境。

「一帶一路」重塑地緣政治：澳門的輔助性功能

利天佑教授
澳門聖若瑟大學

1. What Sets "One Belt, One Road" Initiative Apart?

China seems to be committed to leadership in Central Asia, both bilaterally and within multilateral institutions such as the SCO and the proposed new "Silk Road Economic Belt".

European Council on Foreign Relations (2014, page 13).

The People's Republic of China (hereinafter referred to as China) is a State with strategic thinking. Therefore, the economic "*belt and road*" initiative is first, and foremost a **development flexible** strategy. Indeed, it is a brilliant interregional exercise in high-level public and cultural diplomacy, with the potential to deliver a historic contribution to interdependent and interconnected patterns of dynamic interplays **in the age of globalization**, capable of laying the seeds for a **new geopolitical era** (Francis Cheung; Alexious Lee, 2016)[1]. The so-called "*Eurasian bridge*" seems to be the drive to a geo-economic advantage, leveraging trade exchanges, currents of interaction and sovereign cooperation by putting forward a singular **vision of Eurasia as a pivot into the heart of Europe**. The landmark of China's silk economic belt is associated with conditional[2] inclusiveness and oriented "actions of facilitation", where **streamline flows** of material and immaterial **connectivity** feature as major qualities. OBOR is an open-ended, participatory, Eurasian project, with a global and regional impact.

In addition, the "*One Belt, One Road*" (OBOR) initiative baptized by the Chinese leadership refers either to the "*Silk Road Economic Belt*" through Central Asia or to the "*21st Century Maritime Silk Road*" through South and Southeast Asia. At the heart of this initiative lies the creation of an **economic land belt** that includes States on the "*original silk road*" across Central Asia, West Asia, the Middle East and Europe, as well as a **maritime road** that connects South China maritime facilities to the African coast and through the Suez Canal into the Mediterranean Sea. The final outreach of this project aims to unblock the deepest network of connectivity between China and Europe, with a global extent, involving **over 60 States**, representing a third of the world's total economy and involving more than **half the global population**. However, OBOR is not like the Marshall Plan, but a mutual undertaking (Hu Shisheng, 2016)[3], asserted by the Chinese leadership as flexible, intergenerational project, that is expected to strengthen interpersonal relations through investment.

By the same token, the OBOR initiative **is at the heart of The People's Republic of China's "Grand Strategy[4]"** and consequently a central element in Chinese foreign policy. OBOR is not an end itself. As Zhao Xijun (2014)[5] stated: "*The One Belt and One Road initiative is a long-term macroscopic program of strategic development for the entire (Chinese) State.* "Hence, it is possible to decompose OBOR in four complementary and interrelated **core objectives**: (1) Improving

[1] A brilliant plan One Belt, One Road, Retrieved on April 25, 2016 at https://www.clsa.com/special/onebeltoneroad/.
[2] Conditional stands for the interests of all parties involved and the rational of the Chinese initiative.
[3] Patrícia Magalhães (2016). Building the Future, Macao Magazine, May, page 17.
[4] Grand Strategy is a set of long-terms policies among them stands the development of People's Liberation Army (PLA) blue and green navy. According to Tim Marshall (2015, page 44) "… within 30 years China will possess the most powerful seaborne force the world has never seen".
[5] Zhao Xijun, Renmin University, Global Times, Dec 28, 2014.

Regional Infrastructure, (2) Increasing Regional Economic Policy Coordination, (3) Removing Trade Barriers and (4) Encouraging Cultural Ties as Support for the Broader Project". Likewise, as the Chinese National Development and Reform Commission clearly pointed out (2015, footnote 6), OBOR should promote policy coordination, facilities connectivity, unimpeded trade, financial integration and people-to-people bonds.

On one hand, OBOR aims to resettling the terms of economic globalization and therefore rebalancing its Center of Gravity (CoG). On the other, it follows-up the so-called "triangular politics policy (1969-1989)" and envisages countering the alleged unipolar economic hegemony (since 1989). Finally, OBOR is a by-product of China's "Peaceful Development and Rise" doctrine, as a substantial tool leading the State into the landmark of great-power status. Moreover, OBOR is in line with the Confucian tradition, with Five Principles of Peaceful Coexistence (1954), China's Peaceful Development Strategy (2005), China's White Paper on Peaceful Development (2011), and with China's Good Neighbouring Policy. As stated by the Chinese National Development and Reform Commission[6] "***The Initiative is open for cooperation.*** *It covers, but is not limited to, the area of the ancient Silk Road. It is* ***open to all countries, and international and regional organizations for engagement,*** *so that the results of the concerted efforts will benefit wider areas. The Initiative is harmonious and* ***inclusive****. It advocates tolerance among civilizations, respects the paths and modes of development chosen by different countries, and supports dialogues among different civilizations on the principles of seeking common ground while shelving differences and drawing on each other's strengths, so that all countries can coexist in peace for common prosperity".*

Additionally, the frame of such an initiative is infrastructure. Indeed, different types of infrastructure such as shipping, airports, railways, roads, energy, banking, security, information, culture, science, education, logistics, trade, and telecommunication projects, **building capacities** and **expertise**, combining land and maritime dimensions. One can ask why infrastructure? Five main reasons. Infrastructure improves returns, represents a long-term investment, stands as a portfolio for diversification; Infrastructure generates environmental and social benefits (Private Banking Directory Magazine, 2016, page 16); Infrastructure provides an opportunity for real competition between railways, deep-sea port operators and airlift cargo operations (Vladimir 2015, page 29); Infrastructure represents an opportunity for cooperation along industry chains (Chen Bo, 2015, page 48); Infrastructure leverages the trade flows by removing trade barriers. Infrastructure when magnified at this scale of groundwork has the ability to create a **functional soft power** that positively transforms its geo-economic value.

Furthermore, OBOR requires a great deal of **bi and multilateralism**, to attract and to strengthen communication involving existing mechanisms such as the Shanghai Cooperation Organization (SCO), ASEAN Plus (10+1+3+6), Asia-Pacific Economic Cooperation (APEC), Asia-Europe Meeting (49 MS) (ASEM), Asia Cooperation Dialogue (33 MS) (ACD), Conference on Interaction and Confidence-Building Measures

[6] Vision and Actions on Jointly Building Silk Road Economic Belt and 21st Century Maritime Silk Road (2015/03/28), Issued by the National Development and Reform Commission, Ministry of Foreign Affairs, and Ministry of Commerce of the People's Republic of China, with State Council authorization, paragraph II. Retrieved July 4, 2016, at http://en.ndrc.gov.cn/newsrelease/201503/t20150330_669367.html

in Asia (CICA), China-Arab States Cooperation Forum (CASCF), China-Gulf Cooperation Council Strategic Dialogue, Greater Mekong Sub-region (GMS) Economic Cooperation, Central Asia Regional Economic Cooperation (CAREC), Greater Mekong Sub Region Development Project (5 MS) and the Greater Tumen Initiative (China, Mongolia, Korea, Russian Federation).

Indeed, this policy is part of a **multilateral, inclusive, long-term strategic vision**, and therefore there is no Silk Road Economic Belt without the Maritime Silk Road, there is no "Grand Strategy" without OBOR. Geopolitics affects every State. OBOR is about geopolitics as it relates geography, infrastructure and economic power.

2. Is OBOR Reshaping the Maps of the Future?

China cannot develop in isolation from the rest of the world, nor can the world enjoy prosperity and stability without China.

Hu Jintao's 17th National Party Congress Report (2007)

In the study of the larger long-standing Chinese economic strategy, we cannot turn a blind eye to the global perspective. Only China can bring the OBOR initiative to full success, as a win-win game, and only China can divert the concept "*made in China*" (marketing at lowest price) into "*innovated in China*" (technological advantage). It actually sounds like the phrase "***community of common destiny***" that was officially adopted in Hu Jintao's 17th National Party Congress Report (2007) to describe the special cross-strait relationship between mainland China and Taiwan… has been extended to OBOR. Solid steps were taken in implementing the "go global" strategy and the open economy entered a new stage of development[7]. Hong Junjie (Shanghai Forum 2016) mentioned that OBOR initiative is to build a community of interests, responsibilities and destiny… a new development model of infrastructure connectivity, which is proved to be beneficial to all involved countries". Ever since, Beijing's diplomatic language has been keen to use this term (community of common destiny) to emphasize important and unique relations with other States, particularly China's neighbours and the same expression is nowadays expanding to an interregional level. However, OBOR goes further. The Chinese leadership's idea is to combine OBOR projects with other Chinese cooperative investments worldwide. As mentioned before, there is no Silk Road Economic Belt without the Maritime Silk Road. Moreover, there is no OBOR without the rational of Chinese infrastructural cooperation projects worldwide. They are definitely part of the same strategy. As depicted in figure 1 OBOR is physically described as a set of key infrastructural initiatives, distributed according to a rational One Land Belt (area). It includes six economic corridors (1) (NCMREC) Northern China-Mongolia-Russia Economic Corridor, (2) (CELBEC) Central Eurasian Land Bridge Economic Corridor, (3) (CCAWEC) China-central Asia-West Economic Corridor, (4) (CPEC) China-Pakistan Economic Corridor, (5) (BCIMEC) Bangladesh-China-India-Myanmar Economic Corridor and (6) (CIEC) China-Indochina Economic Corridor and one Maritime Road, with different sailing options[8] as depicted in the figure:

[7] The Community of Common Unity envisages consolidating and reinforcing domestic unity and stability, to establish a new type of power relations in the international arena, and to promote neighborhood stability.

[8] http://china-trade-research.hktdc.com/business-news/article/One-Belt-One-Road/The-Belt-and-Road-Initiative/obor/en/1/1X000000/1X0A36B7.htm

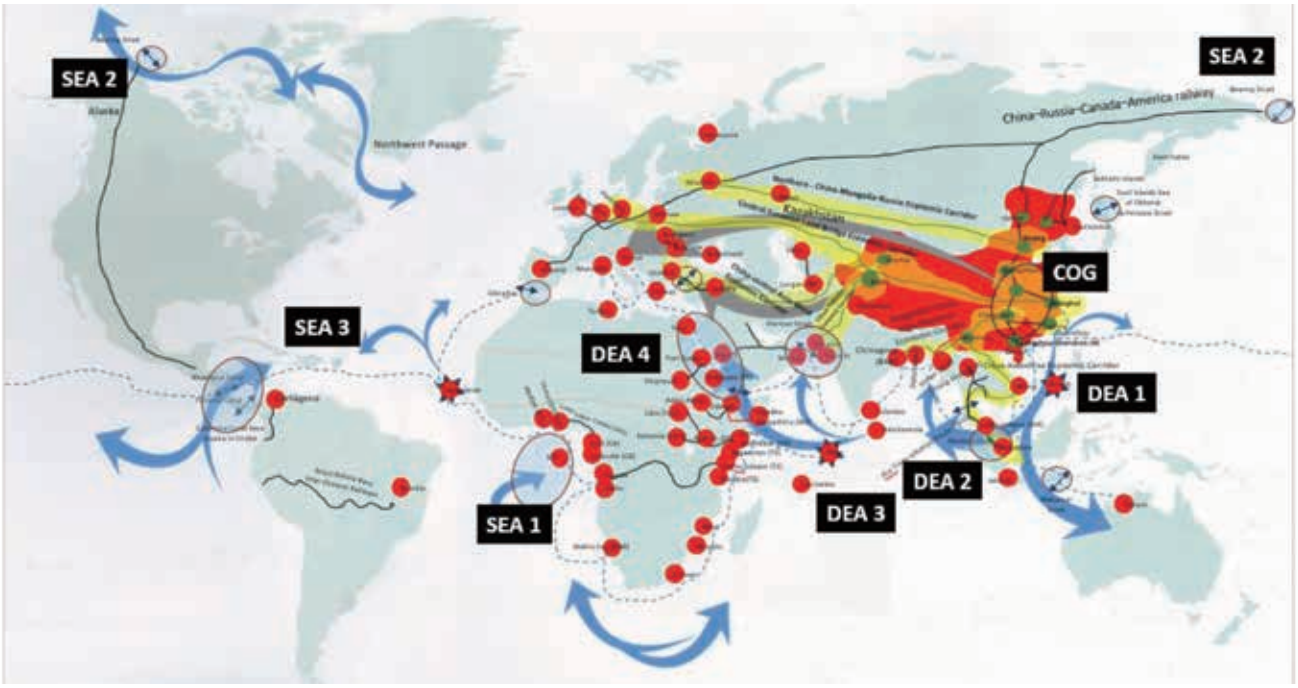

Figure 1 – Fragments of the "Grand Strategy" - One land belt with six economic corridors and one Maritime Road

If we enlarge the perspective, one may say that the heart of the OBOR initiative for the Eurasian region is undeniably its Center of Gravity (defined later in this chapter), which must be combined with Decisive Engagement Areas (DEA), and Secondary Engagement Areas (SEA). This vision extends OBOR reach from an interregional scale to a global scale.

DEA 1 – (East, South and Southeast China Sea[9]) China commands three seas: The Yellow Sea[10], the East China Sea[11] and the South China Sea[12]. Therefore, China is not a landlocked State. However, geography confines all incoming and outgoing vessels heading Chinese harbors to the control of other States. In geographical terms, China is not landlocked State but all the Sea Lines of Communication (SLOC) are practically leading towards three dead ends. That is why the maritime area **defined by Dongsha Pratas, Huángyán Dǎo (黄岩島) (Scarborough Shoals), Nánshā Qúndǎo (南沙群島) (Spratly Island Group)**

[9] The South China Sea is a semi-enclosed sea in the western Pacific Ocean spanning an area of almost 3.5 million square kilometers. It is a crucial shipping lane, a rich fishing ground, and believed to hold substantial oil and gas resources (arbitral tribunal constituted under Annex VII to the 1982 United Nations Convention on the Law of the Sea between the Republic of the Philippines and the People's Republic of China, award on Jurisdiction and Admissibility, 29 October 2015, page 1 point I.3).

[10] Confined by the Korean Peninsula.

[11] Confined by the Korean Strait, Eastern Sea of Japan; Ryukyu Islands (chain of islands between Japan and Taiwan); and the Strait of Taiwan.

[12] Confined by Formosa Island, Luzon Strait, Archipelago of Philippines, Sulu Sea, Java Sea and Malacca Strait.

[13] According to Tim Marshall (2015). Prisoners of Geography, Elliott and Thompson Limited, page 49, "… 80% of the energy supplies pass throughout Malacca Strait…" and (page 11) "… Saudi Arabia is the biggest supplier of crude and oil to China".

[14] Retrieved on July 8, 2016 at http://www.iims.org.uk/kra-canal-project/

and Xisha (Paracel) archipelagos is extremely important – This maritime area facilitates the SLOCs to Eastern China Sea, to Makassar Strait (and then to Australia and the South Pacific), to Malacca Strait and to the Java Sea. Moving into the East China Sea the Diaoyutai (Senkakus) archipelago and the Ryukyu Islands (North West of Taiwan) are strategically important to access the Pacific Ocean, due to the fact that the passage through the Sea of Japan towards Sakhalin islands is not an alternative to commercial navigation (there is the limitation of the La Perouse Strait and the Kuril Islands in the Sea of Okhotsk).

DEA 2 – (South and Southeast Asia) **The Alternatives to Malacca Strait** [13] – This maritime area represents an enormous constraint to SLOC for commercial sailing. Therefore, China has plans to develop the Kra Trans-isthmian Route (or the Thai Canal, also known as Kra Canal or Kra Isthmus Canal). This project refers to proposals for a canal that would connect the Gulf of Thailand and the South China Sea with the Andaman Sea across southern Thailand, as an alternative to Malacca Strait (one of the busiest shipping lanes in the world, with 60,000 passages annually – 1.7 miles across)[14]. Likewise China is interested in the trans-Myanmar oil and gas pipeline (Sittwe), in the trans-Asian railway from Kunming (China) to Singapore, as an entry commercial corridor towards Yunnan Province, or as an alternative, to use the China Pakistan Economic corridor (CPEC[15]) running from Gwadar-Islamabad (Pakistan[16]) deep port facilities to Kashgar (Xinjiang Province) in mainland China[17]. In the context of the CPEC, the Turkmenistan-Afghanistan-Pakistan-India Pipeline (TAPI), also known as Trans-Afghanistan Pipeline, is a natural *gas pipeline* being developed by the Asian Development Bank, and the involvement of China may bring a different dynamics to the initial involvement of USA in order to reduce influence of Russian Federation in Turkmenistan. However, in the context of building railways connecting China to Singapore, Lao People's Democratic Republic (LPDR) represents the key partner to the Chinese administration, due to its hydric potential and because China has no land borders with Thailand. Therefore, the CIEC also depends on the Kunming (China) – Luang Namtha (Laos) – Vientiane and the Lao Bao (Vietname) – Savannakhet (Lao) railways[18]. By the same token, the Mekong river represents and extraordinary potential due to the fact it runs through China's Yunnan province, Myanmar, Laos, Thailand, Cambodia and Vietnam.

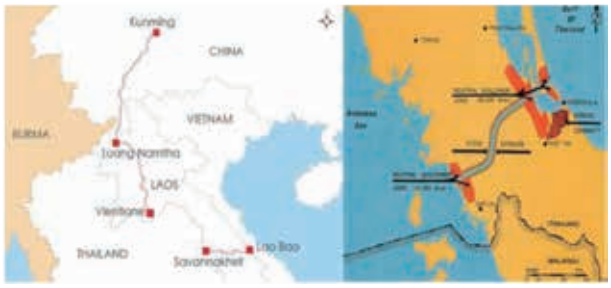

Figure 2 – The importance of Laos and Thailand to OBOR

DEA 3 – (Indian Ocean) **The Archipelagos of the Maldives & Seychelles** – This maritime area represents a rotational platform to maritime navigation (SLOC) with several options: (1) towards the Gulf of Bengal (via Hambantota/

[15] For more details, see the Joint Declaration China Pakistan (Islamabad, April 2015).
[16] In 2005, Pakistan and China signed the "Karamay Declaration" defining Pakistan's role in China's One Belt, One Road (OBOR) initiative.
[17] The DEA 1 and DEA 2 combined will transform China in a two-ocean Power (Pacific and Indian Oceans).
[18] Retrieved on July 8, 2016 at http://www.rfa.org/english/news/laos/railway-06062013161030.html
[19] Ethiopia is commonly known as African water tower, because it is mountainous and water rich. China is financing a hydroelectric joint project in Ethiopia (Blue Nile project). The Grand Ethiopian Renaissance Dam formerly known as the Millennium Dam.
[20] China is Sudan biggest trading partner (2015).

Sri Lanka); (2) towards the Strait of Hormuz; (3) towards the Malacca Strait; (4) towards the Djibouti (Babel Mandeb Strait) in direction of Suez – land later to Venice (Italy), Marseille (France) or Piraeus (Greece); (5) towards CPEC that runs from Gwadar deep port facilities to Kashgar (Xinjiang Province) in mainland China, boosting commerce amongst Pakistan - Afghanistan – Tajikistan - China; (6) towards the Horn of Africa and the African Southern Region.

DEA 4 – (Indic Ocean) **The Horn of Africa and the Red Sea Region** – This maritime area represents a platform to access central Africa, from three anchor points, using a network of railways:

(1) Access to Djibouti (towards Ethiopia[19], Somalia, Sudan[20], Egypt, and Eritrea);

(2) Access to the Great Lakes Region - Mombasa / Bagamoyo / Mombas - Kisumo (Kenya) (towards Uganda, South Sudan, Democratic Republic of Congo, Rwanda, and Burundi);

(3) Access the economic communities in southern Africa (SADC/ECCAS/EAC) - Mtwara (Tanzania) as an entry commercial corridor towards Zambia and Angola (Lobito Railways and Luanda International Airport) (Atlantic South).

The Horn of Africa and the Red Sea Region also engages sea routs to access to Suez Canal and to Madagascar Strait.

SEA 1 – (South Atlantic Ocean) **The Gulf of Guinea** – This maritime area is part of a SLOC from the Cape (South Africa) to the Mediterranean Sea accessing a commercial entry corridor towards Gabon, Cameroon, Nigeria, Ghana, Ivory Coast and Benin. The Gulf of Guinea offers an abundance of fishing resources, raw materials and developing markets. Four Portuguese-speaking countries are strategically located in the area:

- Guinea-Bissau and Cape Verde are located in the northern exit of the Gulf, prolonging Sahel into the Atlantic Ocean and offering a platform to support navigation towards USA, European Union, Europe, Brazil (MERCOSUL Member State) and therefore an extension of the sea corridor towards South and north Atlantic, bringing new opportunities to generate revenues;

- The position of São Tomé e Principe dominates the maritime routes crossing the Gulf in both directions: North-south and East-West, and therefore offering a deep waters port to support the extension of the sea corridor;

- Finally, Angola (including Cabinda) a country belonging to two economic communities (Economic Community of Central African States (ECCAS/CEEAC) and the Economic Community of West African States (ECOWAS), occupies a long costal area and with an EEZ covering a good part of the maritime gulf dimension.

In future, an international railway connecting Cameroon-Nigeria-Benin-Togo-Ghana will unite the coastal area. The Gulf of Guinea is part of the South Atlantic Ocean maritime belt, connecting South America and South African continents.

DEA 4 and SEA 1 are Africa related. Indeed, China has placed itself between 2000 and 2013 as the

[21] Retrieved on July 4, 2016, at https://www.chinafile.com/infographics/visualizing-chinas-aid-africa

second larger donor to African States. China has made available grants, interest-free loans and low-interest loans to many different States. China has involved hundreds of State owned and private corporations in building infrastructures worldwide, with particular emphasis in Africa and thorough the Forum on China-Africa Cooperation (FOCAC). According to the White Paper of China's Foreign Aid published by Chinese Government in 2011, the distribution of China's foreign aid in 2009 was as follows: Africa was leading the chart at 45.7%, with Asia 32.8%, Latin America 12.7%, Oceania 4.0%, Europe 0.3%, and others 4.5%. Given the focus China has put on Africa in recent years, it is reasonable to assume that about half of China's foreign aid goes to Africa at present (Lan Xue, 2014, page 11). In 2009 China became the second larger African trade partner after Europe (Source WTO, Trade indicators 2000-2012). In January 2005, China implemented the Special Preferential Tariff Treatment (SPTT), removing tariffs from some 190 items exported to China from 25 of the least developed countries in Africa. The tariff-free items were increased to over 440 in November 2006 and to 466 by 2007 (Wang, 2007, and Xie, 2008). According to China Commerce Yearbook (2003-2008) Libya, Sudan, Angola, Nigeria and Algeria are the African States with which the China economic cooperation were the most significant. As the figure 3 displays[21] (between 2000-2013), China has invested in Africa mainly in the transport and storage sector and it has invested in some of States referred on DEA 4 and SEA 1: Sudan, Angola, Nigeria, Ethiopia, and Kenya. That conclusion is in line with OBOR global strategy, prolonging the OBOR African reach.

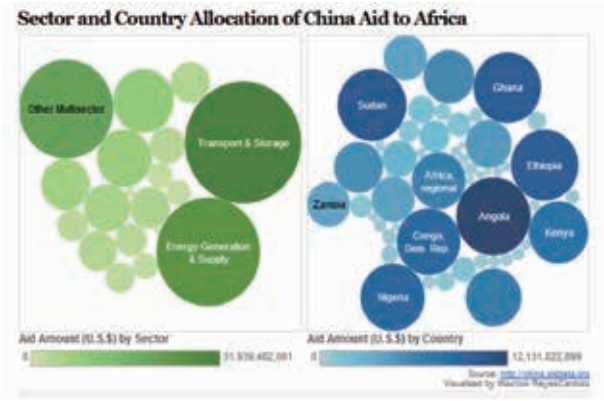

Figure 3 – China Sectorial Investment in Africa

SEA 2 – **The Bearing Strait** – Represents one of the vital SLOC for global shipping and its importance for China as a global trader is growing[22]. Furthermore, access and the free crossing of the Arctic Region is gaining vital importance[23], especially in terms of research, environmental management, navigation security, natural resources, investment in infrastructures, and protection of indigenous populations. There are only three commercial corridors into the arctic, connecting Asia to Europe: the Baffin Bay (Northwest Passage), the Greenland/Norwegian Sea (Northern Passage), and the Bearing Strait, which is common to both passages. China needs to sail freely all these corridors, most of

[22] Since 2013, China is one of the twelve observers (non-arctic countries) and the primary role of observers is to observe the work of the Arctic Council, observers should continue to make relevant contributions through their engagement in the Arctic Council primarily at the level of Working Groups. Source: Retrieved on April 28, 2016, at http://www.arctic-council.org/index.php/en/about-us/arctic-council/observers.

[23] Cheng Baozhi (2015, page 64) "… Although China seems very far away from Arctic Circle… the North Pole impact is true to china's development. Thus, the issue of climate change and environmental protection in Arctic could be a powerful, convincing argument for China to participate in the arctic affairs".

[24] The Panama Canal has been expanded and this inauguration has taken place in Jun 2016. Taiwan's Evergreen Marine Corp. Ltd. (長榮集團) invested massively in Panama and Taiwan is a major user of the canal. According to an important official from Tawain Jason Yuan, the opportunity stands as "golden." He particularly mentioned "I would say that to invest in Panama is the smartest thing to do," Yuan asserted. "If you know the potential of the Latin American market, you should immediately take advantage and come to Panama to invest." Retrieved on 27 June 2016, at http://taiwaninfo.nat.gov.tw/ct.asp?xItem=16549&ctNode=103

them under control of Canada, USA and Russian Federation. Finally, another mega project is the challenging railways project connecting China-Russia-Canada-USA.

SEA 3 – The Maritime crossing points from the North Atlantic to the North Pacific - This maritime area is located in the central Caribbean Sea and is composed by the Nicaragua Canal, the Panama Canal[24]. The project of building an alternative to all maritime crossing options, which will connect Cupica to Urabá (Colombia) by a modern railway, is important to China. Furthermore, the Inter-oceanic-railway (or Atlantic-Pacific Railways) connecting Brazil-Bolivia-Peru has not yet been abandoned and China has been an active partner.

One also may attempt to define the OBOR Center of Gravity (CoG) as mentioned in figure 1. This OBOR COG connects the vertices of the triangle composed of China's Heartland (or the Central Plain), the Pan Pearl River Delta Area and the axis Shaanxi-Gansu-Qinghai-Xinjiang Provinces.

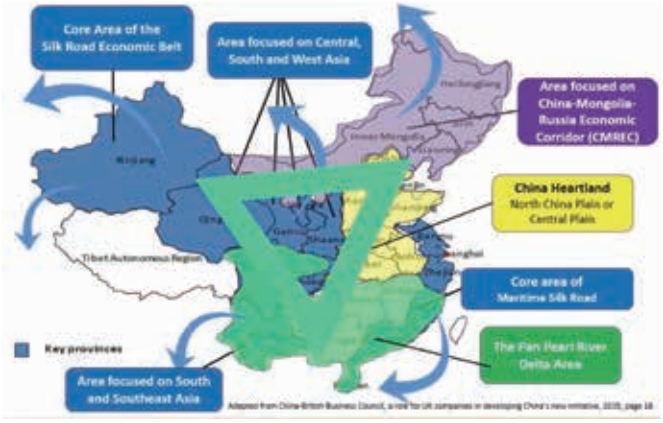

Figure 4 – The central triangle and the new globalization COG

Indeed, the central triangle is probably the new globalization center of gravity, if OBOR is completed as planned. Thus, the new globalization CoG is composed of a set of large areas as it follows:

(A) Harbin-Dandong-Dalian (Heilongjiang Province) and a pivotal economic corridor of mobility towards the Russian Federation, overcoming the difficulty of using the Port of Vladivostok;

(B) Beijing metropolitan area, the Great Wall - Grand Canal (inner communication) - Yellow River (Yellow Sea Access) - Yangtze River Delta (East China Sea Access) – the Bohai Rim Region;

(C) Xián/Shandong (Shandong Province)/ Zhengzhou (Henan Province) – and a pivotal economic corridor of mobility towards Urumqi (Xinjiang), that also runs towards central Europe. In the opposite direction, the same corridor runs to Shanghai. Particular emphasis should be given to the fact that Shanghai is connected by railways to Lhasa and to the fact that freight can be transported by train from Lanzhou (Gansu Province) to Kathmandu (Nepal) via Tibet;

[25] THE GOVERNMENT OF HKSAR (2014). The Greater Pearl River Delta, Report commissioned by Invest Hong Kong, 7th Edition, page 28.

Figure 5 – Development Zones

Figure 6 – Security Hot Spots

(D) Chengdu (Sichuan Province)/Chongqing/ Changsha (Capital City of Hunan Province)/ Fuzhou Port – and a pivotal corridor of mobility towards Kunming (Yunnan Province), furthermore running to Vietnam and Thailand; the economic corridor of mobility towards Shanghai by the River Yangtze; the corridor of mobility towards Guangdong; the corridor of mobility towards Xingjian and central Europe;

(E) Finally, the pentagonal regional arrangement embedded in the GPRDZ as part of the South PPRDA (in Guangdong Province) (Figure 5[25]).

OBOR is reshaping the maps of the future through a global multidimensional infrastructure network. OBOR is a major brick that makes sense out of a wider wall of Chinese economic strategy, and therefore holds enormous potential to **reshape geo-economic maps, at regional, interregional and probably at global level.** It would be fair to say that the success of OBOR will be measured by the way we will all look at maps in the future, most likely with the Indian-Pacific Oceans as primary visual reference.

3. What May Cast a Pall Over OBOR?

Never had a country, no matter how powerful it is, could work independently in the context of economic globalization.

Sha Zukang (2014, page 35)

In the real world, even the most successful enterprise comes at the **expenses of a price.** Indeed, a few hurdles may have the power of jeopardize OBOR. **Firstly**, it is highly dependent

[26] Brazilian Consulate-General Shanghai, Shanghai Forum 2016, China and Latin America: the development partnership of trans-pacific cooperation & sharing.

[27] Measures to guarantee: Financial Institutions: namely, Silk Road Found, BRICS Development Bank, China Development Bank, Asian Infrastructure Investment Bank, China CITIC Bank International, Bank of China, People's Bank of China, China Investment Corporation, SCO Development Bank, International Monetary Fund (IMF), Export-Import Bank of China. Trade measures: bilateral and multilateral FTA, upgrading Sino-ASEAN FTA, Sino-ASEAN Cooperation Fund, RCEP, and FTAAP.

[28] Sanya Declaration of the First Lancang-Mekong Cooperation (LMC) Leaders' Meeting - For a Community of Shared Future of Peace and Prosperity among Lancang-Mekong Countries, 2016/03/23 - Point 6 encourages synergy between China's Belt and Road initiative and LMC activities and projects, as well as relevant development programs of the Mekong countries, including the Master Plan on ASEAN Connectivity (MPAC). Source: retrieved on April 29, 2016 at http://www.fmprc.gov.cn/mfa_eng/zxxx_662805/t1350039.shtml.

on the ability to negotiate with sovereign States, and that places a huge diplomatic burden to the next generation of political leaders and public officials. As wisely Ana Candida Perez (2016)[26] put it, the **differences of geography, language, cultures and political systems is an obstacle to cooperation.** Concurrently, OBOR is a mega economic[27] challenge, involving pharaonic financial assets, demanding time and high level of diplomatic perseverance.

Secondly, great nations do not join alliances; they make their own spaces of comfort to promote important and vital interests. OBOR is a cooperation strategy and as all cooperation strategies is based on common interests. The so-called China's rising is catching the world's eyes… In light of these ideas, some Chinese neighbouring States **seemed skeptical** due to the unbalanced power provided by the project-leading nation, fearing that today's agreements may turn into political chains tomorrow. Partners are wondering what is China's political agenda? The key question seems to be what is China's hidden agenda? The evaluation of OBOR impact in the light of the Sanya Declaration (China and the five Mekong States), in the context of the Lancang-Mekong Cooperation (LMC) (had its initial meeting[28] recently (May 2016)), is particular relevant to explore the possible synergies between OBOR and LMC are at this very initial stage.

Another point addresses particularly the Republic of India as the second largest AIIB shareholder, as BRICS's member and as the father of Project Mausan[29]. India must be attentively understood and carefully dealt with. That is why the Chinese leadership has put forward the "**Three Nos**" Policy (China conducts a policy of no interference in the internal affairs of other nations, China does not seek to increase the so called "sphere of influence", China does not strive for hegemony or dominance) to minimize the eventual hard impact of OBOR policy. In relation to CPEC (see figure 4)[30], we must acknowledge that the area has been suffering from low-level persistent insurgency, with Pakistani authorities blaming India. Sea piracy persists to a relevant problem in the South China Sea, Malacca Strait, Bay of Bengal, Andaman Sea and Java Sea. Separatism, ethnic and Islamic insurgency are hot current problems to be tackled. Likewise, Gulf of Guinea is currently being affected by Boko Haram (based in Chad River Basins: Northern Nigeria, Niger, Cameroons, Central African Republic and Chad) and by Al Qaeda (based in Western Sahel: Mauritania, South Algeria, Mali and Niger (in the banks of Niger River)). In central Iraqi and Syria, the chaotic situation created by Daesh (Islamic State of Iraq and the Levant) is well known. These are only few reasons why OBOR represents a critical point in China's diplomacy, particularly in what concerns neighbourhood policies.

29 The project is considered the Modi Government's most significant foreign policy initiative designed to counter China. It is inspired by India's historical role as the focal point for trade in the Indian Ocean (Akhilesh Pillalamarri, 2014). Retrieved on April, 2016 at http://thediplomat.com/2014/09/project-mausam-indias-answer-to-chinas-maritime-silk-road/

30 Retrieved on April, 2016 at https://www.stratfor.com/analysis/china-dilemma-international-intervention

31 USA is leading the top 15 countries investing in India. Optimism for doing business in India is rising. Sentiment improved when Narendra Modi was elected prime minister on a business-friendly reform agenda in May 2014, though positive signs were evident before the election. According to the Financial Times, in 2015 India overtook China and the USA as the top destination for the Foreign Direct Investment. In first half of the 2015, India attracted investment of $31 billion compared to $28 billion and $27 billion of China and the USA respectively ("India pips USA, China as number. 1 foreign direct investment destination", The Times of India, 30 September 2015).

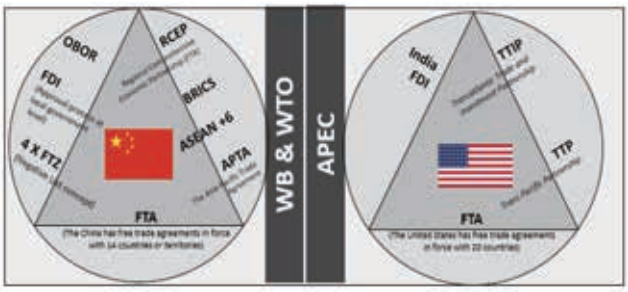

Figure 7– Leading Economic Arrangements

Thirdly, the United States of America perceives OBOR as an instrument to deepening global economic breakdown and as the beginning of concrete steps towards shifting focus from the **Euro-American Atlantic** to the **Indo-Pacific** region. The United States of America is particularly concerned with the combination of OBOR and the "Chinese Grand Strategy" to unconditionally bring on board States across Eurasia, the Middle East, Europe, Africa and some Central America States, into its global plans and thereby blunt the so-called USA "pivot" in the South Asia region. The United States of America's commercial economic strategy to rebalance positively the global American influence relies on the **WTO dominance and bilateral economic relations with India**[31], combined with the "**economic scissors**" composed of the Euro-America Transatlantic Trade and Investment Partnership (T-TIP) and the mega regional trade agreement involving twelve Pacific Rim countries – the Trans Pacific Partnership (TPP/2016). Both T-TIP and TPP exclude China. China uses OBOR, BRICS, "ASEAN + 6" and the Regional Comprehensive Economic Partnership (FTA) (RCEP[32]) to prevent the single country dominance and to avoid escalating rivalry (none of them included USA). USA has free trade agreements (FTA) in force with 20 countries [33]: Australia, Bahrain, Canada, Chile, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Israel, Jordan, South Korea, Mexico, Morocco, Nicaragua, Oman, Panama, Peru and Singapore. Currently, China has 14 FTA[34] signed and implemented: ASEAN, Pakistan, Chile, New Zealand, Singapore, Peru, Costa Rica, Iceland, Switzerland, South Korea, Australia, the Mainland and Hong Kong Closer Economic and Partnership Arrangement and the Mainland and Macau Closer Economic and Partnership Arrangement. Besides, after reforming the FDI system (approval at local government level), and after joining the WTO China has become a foreign investor itself (Wang Zhongmei, 2016[35]). The same author called the attention to the importance of the negative list system available in four FTZ, open to any item not prohibited, in which transparency is at great importance. China is also involved in the Asia-Pacific Trade Agreement (APTA) (China, Bangladesh, India, Lao, Republic of Korea and Sri Lanka).

Fourthly, the Russian Federation is actively involved in the most significant initiatives directly related to OBOR, namely Eurasian Economic Union (EEU) and Shanghai Cooperation Organization (SCO). Undeniably, as mentioned by Jikkie Verlare (2015, page 3)[36] "*China seems very much interested in building on existing regional*

[32] RCEP is a proposed free trade agreement (FTA) between the ten member states of the Association of Southeast Asian Nations (ASEAN) (Brunei, Burma (Myanmar), Cambodia, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand, Vietnam) and the six states with which ASEAN has existing FTAs (Australia, China, India, Japan, South Korea and New Zealand). RCEP negotiations were formally launched in November 2012 at the ASEAN Summit in Cambodia.

[33] Retrieved on July 2016, at https://ustr.gov/trade-agreements/free-trade-agreements

[34] Retrieved on July 2016, at http://fta.mofcom.gov.cn/english/

[35] Wang Zhongmei, Shanghai Forum 2016, China and Latin America: the development partnership of trans-pacific cooperation & sharing.

[36] Clingendael Policy Brief (Dec 2015) based on the research project 'A New Opportunity in EU–China Security Ties: The One Belt One Road Initiative', conducted by Jikkie Verlare at Peking University.

security platforms such as the Conference on Interaction and Confidence-Building Measures in Asia (CICA), the Shanghai Cooperation Organization (SCO) and the ASEAN Regional Forum (ARF) in order to create a new Asian security mechanism… The joining of the SCO by India and Pakistan in 2016 enhances in particular this organization's potential to become a broad multilateral platform for security and economic cooperation throughout multiple regions in Asia". Nevertheless, the Russian Federation perceives OBOR as another **model of economic regional integration**, such as EEU, SCO, or the European Union Neighbourhood Policy. Recently, Russia and China signed a packet of 30 cooperation agreements (June 25, 2016), covering trade, infrastructure, technology, agriculture, finance and energy.

Figure 8 – The ASEAN + 6

Fifthly, as Quanheng (Shanghai Forum 2016) mentioned Asian Economy is vital to the World economy… OBOR with its basic principle will contribute to the overall development of the Asian economy… In fact, in 2014 the OBOR concept was officially unveiled at the Asia Pacific Economic Cooperation (APEC) together with the establishment of a $40 billion silk fund, as a measure to create confidence and to attract partners. In relation to ASEAN + 3 (China, Japan and South Korea) and ASEAN + 6[37] (Australia, New Zealand and India) the key aspect is the OBOR's perception as an instrument to promote economic cooperation and trade balance rather than strategic dominance. At the China-ASEAN Expo in 2013, Chinese Premier Li Keqiang emphasized the need to build the Maritime Silk Road oriented towards ASEAN and to create **strategic propellers for hinterland development**. Accelerating the building of the Belt and Road can help promote the economic prosperity of the countries along the Belt and Road and regional economic cooperation, strengthen exchanges and mutual learning between different civilizations, and promote world peace and development. It is a great undertaking that will benefit people around the world[38]. APEC seems to be the only truly inclusive economic forum where the 21 Pacific Rim member economies (USA included) that

[37] Image Retrieved on July 2016 at https://www.linkedin.com/pulse/20141022062158-36873037-outlook-on-asean-investment-2015

[38] Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road (2015/03/28), Issued by the National Development and Reform Commission, Ministry of Foreign Affairs, and Ministry of Commerce of the People's Republic of China, with State Council authorization, preface. Retrieved July 4, 2016, at http://en.ndrc.gov.cn/newsrelease/201503/t20150330_669367.html

[39] The European Commission is considering if EU could collectively become a member of the Asian Infrastructure Investment Bank (AIIB); The EU is working together with Beijing on governance standards and best practices in setting up the AIIB; China's ambassador to the EU, Yang Yanyi, mentioned that China is looking for ways to build up synergies between the 'One Belt, One Road' initiative and the European Fund.

[40] In 2015, EU (The Council) appointed Peter Burian as a new Special Representative tasked with promoting EU political coordination in Central Asia, monitoring the implementation of the EU Central Asia Strategy and supporting regional security in the region.

[41] Hungary is part of the CEE 16+1 platform and Xinhua commented on the occasion by stating that 'the CEE nations will be essential links in the Belt and Road initiative' - Shannon Tiezzi (2015). Where is China's Silk Road Actually Going? The Diplomat (30 March).

[42] Macedonia and Greece both expressed their willingness to partake in the project, which plans to turn Piraeus, the main port of Greece, into a Chinese hub for trade with Europe.

promotes free trade throughout the Asia-Pacific region. The greatest challenge seems to be the OBOR diplomatic linkage to the South China Sea disputes.

Sixthly, the European Union (EU) seems to perceive OBOR initiative as an opportunity to rebalanced EU-China cooperation, which cannot be ignored. In the light of the reasoning, EU is **attempting to respond collectively to the OBOR initiative**, adjusting its own policies to what seems to be considered a historic geo-economic opportunity, namely 'The European Neighbourhood Policy' (that has to be adapted to the context of BREXIT); 'The EU Maritime Security Strategy"; and "The EU Partnership Instruments'. Actually, there are signs leading to a closer positioning between EU and PRC in relation to OBOR. The EU is involved in the capital arrangements and governance mechanisms to financially sustain OBOR[39], the ties between EU and China are expanding to new areas as stands the example of EU–China strategic partnership addressing areas now beyond bilateral economic relations and the EU has developed a Central Asia Strategy to be implemented by the new EUSR Peter Burian[40]. China approaches the EU at institutional level and at bilateral level. The creation (2012) of the CEE 16+1 platform has lead Hungary to become the first European country to sign a memorandum of understanding with China on promoting the 'Belt' and 'Road' (2015)[41]. In 2015 the Forum on China–Europe Investment and Connectivity Cooperation was held, and China (Suzhou) hosted the fourth China-Central and Eastern European Summit, in which had been highlighted the OBOR role of Eastern Europe, Balkans and Baltic States… China also signed a deal with Hungary and Serbia to build a high-speed rail line between their capitals as part of a broad plan for a rail link to the Greek Port of Piraeus[42]. "At the 17th EU-China Summit (2015), the EU and China confirmed their strong interest in each other's investment flagship initiatives, namely the Investment Plan for Europe, and the "One Belt, One Road" initiative. The EU and China also support efforts to improve connectivity in Asia for the benefit of all European and Asian partners. The EU-China Connectivity Platform, was established in 2015, to promote cooperation in infrastructure, encompassing financing, interoperability, logistics, and maritime and rail links across the Eurasian continent"[43]. Eventually, the EU will realize the advantages of a Sino–European Strategic Partnership framework to engage with OBOR within the scope of the EU neighbourhood policy. Sooner or later, the EU will be involved in the financial synergies that a project such as the OBOR might generate, because China and the EU need one another, despite of all reserves (EU Parliament last May 12, 2016 rejected the attribution of the market economy status to China). Unfortunately, for the EU, an EU common policy on OBOR does not necessarily prevent *ad hoc* agreements between EU member States[44] and third actors and that fact may cast a shadow over the EU strategy as such.

[43] EU-China Relations Fact Sheet, Brussels, 22 June 2016, page 2 (EU in Hong Kong and Macao-E-Bulletin, Issue 23 - 2016 of 23 June 2016).

[44] Alessandro Arduino (2016). Policy Report, China's One Belt One Road: Has European Union Missed the Train? Page 3 - EU needs to adopt a common voice to engage China's OBOR initiative; to promote stakeholder participation; to coordinate crisis prevention; and to avoid focusing only on short-term economic gains to attract China's outbound direct investments. Source: retrieved on April 28, 2016 at https://www.rsis.edu.sg/wp-content/uploads/2016/03/PR160307_China-One-Belt-One-Road.pdf.

[45] Stratfor (2016) China: The Dilemma of International Intervention, Retrieved July 7, 2016, at https://www.stratfor.com/analysis/china-dilemma-international-intervention

Finally, OBOR has been designed to create **streamline flows**, therefore it generates interregional closeness, and closeness decreases the ability to safeguard, to regulate, and to act independently, given that every flow works both ways. Actually, peaceful proximity generates a high level of interdependency and tends to facilitate room for the so-called three evil forces: terrorism, extremism and separatism. In relation to violent threats, "Beijing … has struggled to find sufficient security arrangements for land routes through known trouble spots such as Afghanistan and Western Pakistan. It has also dedicated aircraft carriers to a future role of securing key maritime routes that fall under Belt and Road. In short, as China adjusts its legal structure to allow overseas actions and restructures its forces to be able to carry out such actions…"[45] In Addition, there is an adverse force, associated to the perception that many private entrepreneurs, do not really seek to deliver a contribution to social development. Inversely, they merely understand OBOR, as an opportunity to increase their personal wealth, displaying no regards for social goals.

4. What would be the MSAR role in the OBOR's context?

We should leverage the unique role of overseas Chinese and the Hong Kong and Macao Special Administrative Regions,
and encourage them to participate in and contribute to the Belt and Road Initiative.

Chinese National Development and Reform Commission (2015, paragraph 1)[46]

Attempting to forecast the future of Macau Special Administrative Region (MSAR), without considering it within the framework of People's Republic of China (China) is doomed to fail. Inversely, perhaps what is worthy to ponder, is to anticipate the future of MSAR in the context of trend denominated "China going global", within the agenda of the much talked "one belt, one road" initiative, as a substantial target for China's foreign commercial policy. Historically, Macau (and Hong Kong) were been perceived by many[47] as a Chinese pivot to Europe and the Western World embracing the real spirit of the Silk Road. This statement takes as assumption an imbalanced position of China in relation to the international system driving forces. OBOR is an initiative that potentially will deliver a substantial contribution to change that.

The year 2008 stands as a token of Chinese national revival, capitalizing on the success of the Beijing Olympics. Undeniably, after a century of humiliations (1840-1940), China has learned a decisive lesson, and therefore has acquired a sense of pride, departing from the fact that CCP State policies are lifting millions out of poverty, are lessening social inequality, and are increasing the overall living standards. China has indeed understood how to combine essential values springing out from Confucianism and Socialism, such as ancestors' reverence and family centrality, with the crucial requirement that relates State economic empowerment to State social development. This line of reasoning, sets the scene, represents the long reach beacon guiding the future of MSAR and provides sense to a dual smart formula designed by Deng Xiaoping: on

[46] Vision and Actions on Jointly Building Silk Road Economic Belt and 21st Century Maritime Silk Road (2015/03/28), Issued by the National Development and Reform Commission, Ministry of Foreign Affairs, and Ministry of Commerce of the People's Republic of China, with State Council authorization, paragraph VI. Retrieved July 4, 2016, at http://en.ndrc.gov.cn/newsrelease/201503/t20150330_669367.html

[47] Zhidong Hao (2011). Macau History and Society, Hong Kong University Press/University of Macau, Chapter 2; Geoffrey C. Gunn (2005). Encountering Macau, Published by the author; Carmen Amado Mendes (2013). Portugal, China and the Macau Negotiations, Hong Kong University Press; Moisés Silva Fernandes (2006). Macau na Política Externa Chinesa: 1949-1999, Lisboa Imprensa de Ciências Sociais.

the one hand, political sovereignty and economic independence are inseparable, and on the other hand, political statehood is grounded on "one country, two systems" principle.

MSAR retrocession to Chinese sovereignty is also part of national revival and therefore the negotiations concluded in 1987 with Joint Declaration of the Government of the People's Republic of China and the Government of the Republic of Portugal on the question of Macau, represented a tremendous opportunity to envisage the creation of an "entity" internationally relevant and nationally integrated. MSAR contribution to the national revival is more effective as it leverages a positive differentiation from regional, sub regional and national dimensions. Remarkably, Macau's positive differentiation has the potential to deliver a substantial contribution to current Chinese national goals.

Figure 9 - The Pentagonal Regional Arrangement

Historically speaking, Macau, as a territory under Portuguese administration (until 1999), played an important role as part of Chinese foreign policies, namely in relation to commerce of commodities, trade exemptions, diplomatic action, facilitation of Chinese operations in the Korean conflict and currency affairs. In the context of OBOR, MSAR[48] destiny is to keep contributing to Chinese foreign policies, as part of the **pentagonal regional arrangement composed of Zhuhai - Guangzhou - Shenzhen - Hong Kong - Macau** (in Guangdong Province) located in the banks of the Pearl River Delta Bay. Furthermore, the departing point to understand the contributing role of MSAR, is grounded on its uniqueness as a non-sovereign special administrative Chinese territory, in which statehood is grounded on "*one country, two systems*" principle. MSAR holds a functional power in the comprehensive OBOR framework, which can be **potentiated in the context of regional integration.** The driver policy instrument for Pearl River Delta Bay seems to be the idea put forward by the State Council in 2004, named "9+2" strategy (Nine Main land Chinese provinces, MSAR and HKSAR). The five-year Plan (2016-2020) relies on this strategic document, in order to create, integrate and enlarge the Greater Pearl River Delta Zone (GPRDZ), covering a third of the Chinese population, and a third of the Chinese economic value. The Chief Executive Report on the promotion of moderate economic diversification in the MSAR takes into account the same key reference and the platform for commercial cooperation between china and Portuguese-speaking countries (PSC).

In addition, the GPRDZ is not the only integration zone deeply related to OBOR. The Pan Pearl River Delta Area (PPRDA), depicts a regional ability to plan economic integration, as shown on figure 6[49]. PPRDA is composed of Sichuan, Yunnan, Guizhou, Guangxi, Hunan, Guangdong, Jiangxi, Fujian and Hainan. The PPRDA gives

[48] Macau Special Administrative Region of People's Republic of China.
[49] Retrieved on 24 June 2016, at http://www.mdpi.com/2071-1050/6/8/5203
[50] Around 50% of the world population is living within a 5 hours flight.

full sense to the Mainland, Macau, Hong Kong Closer Economic Partnership Arrangement (CEPA), to the cooperation between the six international airports located in the GPRDZ[50], to the Hong Kong-Zhuhai-Macau Bridge, to the establishment of free trade zones, and to Guangzhou-Shenzhen-Hong Kong high speed railway. The regional integration has also been extended to maritime domain, especially in the area of research and development, with particular emphasis to Guangxi, Guangdong, MSAR, HKSAR, and Fujian. The PPRDA is the natural connections with the origin of the maritime Silk Road and with the modern Indochina economic corridor.

Figure 10 – The Pan Pearl River Delta Area

By the same token, the future of MSAR, lays within the combination of four pillars representing that positive differentiation: **location, heritage, specialization** and **international status**. The idea of economic diversification paves the way to better understanding the future of Macau, but is has not yet been sufficiently developed. Actually, diversification must be understood in the sense of positive differentiation, departing from the four pillars mentioned before. Furthermore, the eventual sub regional integration of MSAR in the GPRDZ does not necessary mean economic similarity but it does mean being part of the "**China's Regions in the pursuing opening-up**"[51]. In fact, Macau's positive differentiation or at the best its ability to supplement that, gives right sense to the dual smart formula designed by Deng Xiaoping.

Figure 11 – MSAR Location and the Tributaries of the Pearl River Using Digital Chart of the World and GTOPO Data

[51] This expression is used in the document named: Vision and Actions on Jointly Building Silk Road Economic Belt and 21st Century Maritime Silk Road (2015/03/28), Issued by the National Development and Reform Commission, Ministry of Foreign Affairs, and Ministry of Commerce of the People's Republic of China, with State Council authorization, paragraph VI. Retrieved July 4, 2016, at http://en.ndrc.gov.cn/newsrelease/201503/t20150330_669367.html

[52] As of December 2015, all of the 57 Prospective Founding Members of AIIB had signed the Articles of Agreement. The initial signatories were Australia, Austria, Azerbaijan, Bangladesh, Brazil, Brunei Darussalam, Cambodia, China, Denmark, Egypt, Finland, France, Georgia, Germany, Iceland, India, Indonesia, Iran, Israel, Italy, Jordan, Kazakhstan, Republic of Korea, Kyrgyz Republic, Kuwait, Lao PDR, Luxembourg, Malaysia, Maldives, Malta, Mongolia, Myanmar, Nepal, Netherlands, New Zealand, Norway, Oman, Pakistan, Philippines, Poland, Portugal, Qatar, Russia, Saudi Arabia, Singapore, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Tajikistan, Thailand, Turkey, the United Arab Emirates, the United Kingdom, Uzbekistan, and Vietnam. The AIIB Articles of Agreement entered into force on 25 December 2015. On 16 January 2016, the Board of Governors held its inaugural meeting, declaring the Bank open for business and electing Mr. Jin Liqun as President for an initial five-year term. Retrieved on July 4, 2016 at http://china-trade-research.hktdc.com/business-news/article/One-Belt-One-Road/The-Belt-and-Road-Initiative/obor/en/1/1X000000/1X0A36B7.htm

[53] Plataforma Newspaper, September 1, 2015, page B8.

[54] Economic Community of West African States, Southern African Development Community, and Economic Community of Central African States.

[55] For more details: http://macaunews.com.mo/red-long-reach-beacon-future-macau/

There are two perspectives on relations between OBOR and the Portuguese speaking countries (PSC). On one hand, the Community of Portuguese Speaking Countries (CPLP) has established itself as a language organization, with an economic and diplomatic purpose. Furthermore, the CPLP has a close relationship with the **South Atlantic belt**, with three supporting points (Portugal – an entry to EU and a founding father of the Asia Infrastructure Bank (AIIB[52]); East Timor as a natural candidate to ASEAN and MSAR as a natural entry/exit point to China)[53]. Particularly interesting in the OBOR context is its proximity to the Gulf of Guinea (Angola, Cape Verde and São Tomé e Principe), its presence in three African Economic Communities[54], MERCOSUL, the EU and the business potential of the Portuguese language as a whole. On the other hand, there are the bilateral relations where China-Brazil China-Angola bilateral ties are the most substantial in terms of commerce and they do not depend on MSAR's role to develop. Actually, with the exception of São Tomé and Principe, all the remaining Portuguese Speaking Countries have established themselves actively in MSAR.

All in all, MSAR's **functional soft power**[55] in relation to OBOR might be described as based in its historic **heritage**, departing from a geometrical increment on people-to-people exchanges. Macau is capable to be a reference in terms of leisure and tourism, an interconnecting cultural platform for diplomacy, with high reference educational institutions, and exploring the potential of Portuguese language as a global business language. In this context also stands a "branding power" with a very particular relation with West and European Union, as the second larger trade partner after mainland China[56].

The first pillar, the noteworthy geographic location of MSAR at the western side of the mouth of the Pearl River and at the entrance of the Pearl River bay. The Pearl River is one of the most important rivers in China, together with the Mekong, the Yangtze, the Yellow River and the Grand Canal, they form a remarkable network of waterways. Figure 11[57] shows the **tributaries of the Pearl River**, the **Pearl River Basin** and the watershed or drainage basin is represented in yellow[58]. The long and wide Pearl River Delta includes the dense network of cities that span nine prefectures of Guangdong Province, into the South China Sea. Furthermore, MSAR is connected by road, bridges, railways and jetfoil to all major cities in its vicinity. The high speed railway network reaches Macau from Guangzhou with a fast branch that rains until Zhuhai. From 2010 to 2040, the major destinations of China

[56] MSAR is the largest EU business partner after mainland China (851 million (2015) (↑39%)), it has a legal cooperation program in place to fight against human trafficking, participates in the Horizon 2020 research program, and is actively involved in education program such as ERAMUS+ and the European Union Academic Program.

[57] Authored by map designer Karl Musser.

[58] The Lubao Yong and Xinan Yong Rivers converge with the Liuxi River to form the main branch of the Pearl River just north of Guangzhou.

[59] Retrieved on 22 June 2016, at http://www.seeraa.com/china-travel-tips/china-high-speed-train.html

[60] HK airport is a platform connecting more than 180 different destinations.

[61] According to the Flightglobal Insight 2014, retrieved on 23 June 2016, at https://www.flightglobal.com/sponsored/airbus/airports/

[62] Gaolan Port Economic Development Zone to become the first national economic and technology development zone (NETDZ) on the west bank of the Pearl River Delta. The newly-promoted zone has been named the "Zhuhai Economic and Technological Development Zone."

[63] Jetfoil terminal and deep water port.

[64] Retrieved on 23 June 2016, at http://en.gzport.com/en/item/3.aspx

will be interlinked and finally formed a national railway network in the 30 years' development… the Beijing-Guangzhou High-Speed Railway, links capital of China to the South centre of China[59]. There are six international airports located in the Pearl River bay area (within a radius of 200 Km): Macau International airport, Baiyun International Airport (Guangzhou), Jieyang Chaoshan Airport (Shantou), Bao'an International Airport (Shenzhen), Jinwan Airport (Zhuhai) and Hong Kong International Airport[60]. The Hong Kong International Airports ranks among the top 10 (2014)[61] in terms of traffic and it is the second largest airport in China. There are eight deep water ports located in the Pearl River bay area, which can be sailed to a central maritime corridor of communication, well equipped with maritime navigation signage, namely a system of buoys, poles, beacons and lights is used to assist safe navigation: Zhuahi Gaolan (Zhuhai)[62], Kwai Chung (Hong Kong), Shekou (Shenzhen)[63], Ma Wan & Chi Wan (Shenzhen), Yantian (Shenzhen), Nansha (Guangzhou), Xinsha (Guangzhou), Huangpu (Guangzhou), Downtown Guangzhou Port Area that includes Xinfeng, Henan and Dashatou terminals. Nansha, Xinsha, Huangpu and Downtown ports, located along both sides of the Pearl River, are grouped as the Guangzhou Port Group[64]. **On the one hand**, MSAR economic, infrastructural and policy integration in the GPRDZ and in the PPRDA, is a key factor to understand its functional power, in which **Guangzhou seems to be a key OBOR hub**. Consequently, MSAR will be well integrated in the new globalization COG. **On the other hand**, the GPRDZ needs MSAR as free port, as a perceived "friendly location", as a flexible and open destination and MSAR needs the GPRDZ to obtain the leverage that its small dimension requires. Indeed, when looking at MSAR role in the context of OBOR, is the geopolitical readings of the Portuguese-speaking countries positioning that makes it attractive and weights the importance of MSAR. OBOR is not merely an infrastructural initiative linking the China to Persian Gulf and to Mediterranean Sea, but extends the flow to other areas as identified before.

The second pillar, the **Macau cultural heritage**, syndicates as a driver of positive economic differentiation namely departing from following aspects:

(1) The official and widely spread use of the Portuguese language, and the trilingualism in businesses (Chinese, Portuguese, and English) seen as competitive advantage when compared with Hong Kong;

(2) The nature, the practice and the stability of the legal system and a reliable judicial system based on civil law, an advance commercial law, a competitive banking law, a modern and flexible civil code;

(3) A legacy of European-style practices such as negotiation, arbitration and mediation, and a low level of border trade barriers;

(4) Multicultural material and immaterial historic heritage;

(5) International Universities with European recognition such as the University of Saint Joseph;

(6) An unique relationship with Portuguese-speaking countries, United States of America and the European Union.

MSAR must be a player capable of building confidence in the business international chess game, and its domestic law, side-by-side with (future) advanced dispute resolution mechanisms based on multilingualism, are standing as essential tools to achieve it. Moreover, this second pillar is the landmark of the Macau's role as the

"platform" between China and the Portuguese speaking countries and perhaps in the future, between China and all the Iberia community of States, casting a close eye to the European Union. A platform has to be much more than branding and networking. A platform is not a buzzword. It must be a space of trust, reliance, partaking, facilitation, dialogue, perceptions, security, cultural identity and partnership planning. A platform is an active ground to capitalize on what is shared. All in all, this sort of platform has to be a distinguished level "surface", on which business and services opportunities can find a long-term stand, in order to significantly contribute to "one belt, one road" initiative.

The third pillar, the Macau market specialisation, has to be in line with the second pillar and therefore capable of supporting it. The diversification for a small open economy is inevitably a protracted process with lot of uncertainties and difficulties. It involves a change in economic structure, which requires persistent and determined policy actions (Chan Sau San, 2006, page 27).

Furthermore, MSAR's functional power in relation to OBOR might also be described as its **Asian specialization**, capable of responding to a demand on training, on education, on substantial and reliable financial services, on minimal commercial tax regulations, on deliberate fund raising abilities and on exploring the potential of being economically integrated in the GPRDZ. The expected development of international trade in goods and in services, the new challenges of Foreign Direct Investment (FDI), side-by-side with the growing of the Chinese internal market, will call for another level of quality strategic management. MSAR holds an advantageous position to serve as a service platform for language services, banking, research, quality, management, insurance, litigation, and Alternative Dispute Resolution (ADR) (namely in relation to Arbitration, Negotiation, Mediation and Facilitation). MSAR develops its branding supporting role in a regional context of the GPRDZ, pursuing a policy of great support to sports, cultural and entertainment happenings, exhibitions, fairs, expositions, conferences, seminars, conventions and other large gathering events.

In this dimension, diversification also means positive differentiation, taking advantage of regional and sub regional cooperation, as an unique economic services platform, departing from an important institutional arrangement and from tangible plans. In relation to the former, the following institutions are important players, in close articulation with the MSAR government:

1. Macau Foundation;
2. Forum for Economic and Trade Cooperation between China and Portuguese-speaking countries[65];
3. Macau Trade and Investment Promotion Institute (IPIM);
4. Institute of European Studies of Macau (IEEM);
5. African Chamber of Commerce in Macau;
6. Macau ASEAN International Chamber of Commerce;
7. Business associations such as the Macau European Chamber of Commerce, Macau Association for the Promotion of Exchange

[65] Since 2015 there is the Portal de Cooperação entre a China e os Países de Língua Portuguesa (http://pt.platformchinaplp.mo/)
[66] Hu Angang (2016). Macao's Future, Macao Magazine, May, page 9.\

between Asia-Pacific and Latin America (MAPEL), the France-Macau association, German-Macau Business Association, and the British Business Association of Macau.
8. Macau youth entrepreneur association (MYEA)

In relation to the tangible plans, it seems that a clear idea about the future is governing the construction of the present, leading towards the constitution of another mega city of the planet, through the integration the GPRDZ. In light of this idea, the following are standing as foundational stones:

1. The Policy of "putting people first"[66];
2. MSAR tradition as a free port with law taxation;
3. MSAR Regional Market;
4. The opportunities offered by E-commerce;
5. Plan to Reform and Development of the GPRDZ (2009);
6. The Policy Development of MSAR as a Centre of Tourism and Leisure;
7. The Mainland and Macau Closer Economic Partnership Arrangement (CEPA);
8. MSAR liberalisation of Telecommunications Sector[67];
9. MSAR Industrial and Commercial Development Fund;
10. The three experimental Free Trade Zones (EFTZ) and their links with OBOR;
11. Framework Agreement of Cooperation between Guangdong and Macau;
12. The New Macau Light Rail;
13. The land access of vehicles to Hengqin Island;
14. The fourth bridge between the peninsula and Taipa;
15. The Construction of the Hong Kong-Zhuhai-Macau Bridge.

Zhu Xiaodan, Governor of Guangdong province has repeatedly mentioned (June 21, 2016 – Joint Cooperation Conference Guangdong-Macau) that Guangdong Province pays close attention to investments from and on PSC, Latin Countries and African Countries. In addition, Macau's economy is in some way related to the three new Guangdong Experimental Free Trade Zones (EFTZ) (116,2 Km2): The first, is located in the Hengqin district of Zhuhai, will act as a financial center linking the Guangzhou-Macau-Hong Kong regions. The second, in the Nansha district in South of Guangzhou, will serve as a logistics zone. The third, in the Qianhai district of Shenzhen, which with the completion of railway and road network by 2020, will be within a one-hour commuting radius of the GPRDZ, within a 30-minute commuting radius of Hong Kong. The main arteries of traffic in the region, including the Shenzhen-Zhongshan corridor, Shenzhen Western Port, Shenzhen North Station and Guangzhou-Shenzhen Yanjiang Highway all pass through Qianhai. The rational of these zones is to integrate the GPRDZ, pulling together Guangdong, Hong Kong and Macau into a single economic unit. Nevertheless, these EFTZs are not isolated examples. Likewise, China is developing similar zones in Shanghai, Fujian and Tianjin.

The outline of the Plan for the Reform and Development of the GPRDZ promulgated in January 2009 has consolidated the development

[67] Key Developments: Fibre is cannibalising Macau's largely ADSL-based broadband subscriber based; Market liberalisation and network coverage targets on new entrants is driving fibre investment; Macau's TV market is now officially open to competition; China Telecom Macau launched its commercial 4G LTE network; By the end of 2015 SmarTone had launched 4G LTE services following its official award of 1800MHz/2600MHz frequencies. Source: http://www.budde.com.au/Research/Macau-Telecoms-Mobile-and-Broadband.html

direction of the PRD region as well as the positioning of MSAR as a world-class tourism and leisure centre. In June of 2009, the China State Council endorsed the Overall Development Plan of Hengqin and provided favorable conditions for deepening the trade and economic collaboration between Guangdong and MSAR, as well as providing new ideas for the moderate economic diversification of the city. Furthermore, the signing of the Framework Agreement of Cooperation between Guangdong and Macau, the development of Hengqin Island, the construction of the Hong Kong-Zhuhai-Macau Bridge (that stands a revolving platform makes sense out of the Guangdong pentagonal regional arrangement), the high-speed railways connecting Zhuhai to Beijing and the expansion of Hong Kong Airport, will further consolidate the close ties in the regional Guangdong-Macau-Hong Kong area. These development features will play a vital role in encouraging triangular reciprocation Mainland-Macau-Hong Kong, in terms of economic cooperation and social integration. MSAR's economic diversification through positive differentiation must take into account the following areas, under the rational of regional and sub regional, differentiated and integrated world-class tourism and leisure center, based on economic and commercial advantages:

1. Reasonable, diversified, massive, and transparent gaming industry;
2. Attractive and permanent non-gaming entertainment events;
3. Robust and reliable banking services, pursuing international best practices and adherent to international regulations, namely the Basel standards. Since 2015 the BOC Macau offers liquidation services in renminbi to banks located in Portuguese Speaking Countries;
4. State-of-the art communications and digital tools, namely a technical ability to develop a system of versatile e-governance;
5. Top regional educational system preparing the future generation to deal with international matters, particularly an outstanding tourism education and training sector – accreditation of education system (especially at bachelor's level);
6. Serious political attitude towards sustainable environment;
7. Consensual urban planning, requalification and heritage conservation;
8. Real support to creative industries as a making value activity;
9. Security of individuals and reliability of public institutions;
10. Accessible, competitive, affordable by air, land (railways and highways) and maritime transport infrastructures – particular emphasis goes to fast and reliable customs procedures;
11. A strong political attitude towards protection of foreign direct investments (FDI), investment incentives and the development of individual international business skills;
12. Separate customs territory with an open market economy, enjoying a low level of taxation for corporations not gaming related.

In this regard, the future of MSAR depends upon its ability to construct unique, strong and respected public, semi-private institutions, its aptitude to create conditions to exercise responsible media and to develop an attitude to persistently advance individual skills, respecting the millenary traditions of the middle Empire.

The pillar number four, the **Macau international status**, should be perceived as an instrument of the Chinese sovereignty and national unity that gives international engagement flexibility.

MSAR international status gives the required elasticity to be legally different from other subjects of international law and for that reason, leverages China's economic role at the world stage level. The widely recognised Macau's International Legal Personality, defined by its social and economic legal international capacity, stands as one of the most valuable assets to the future of MSAR, as Chinese territory with the remarkable international legal characteristics. Likewise, the design of its International Legal Capacity as a subject of International Law, tailors a distinguished role wilfully limited to the economic, cultural and social dimensions. Indeed, this pillar has to been seen as the mechanism that reinforces the others, that makes the positive differentiation a major contribution to Chinese national unity and above all, that credits China with another legal and economic instrument, to endure a vast and comprehensive economic strategy, to explore global markets opportunities. Particularly, the MSAR participation in various international fora such as, agreements, summits and international institutions as "Macau, China", holds an enormous potential to leverage the previously identified pillars[68]. Finally, the **uniqueness** of MSAR's international **legal status**, delivers diplomatic flexibility to exercise presence in international fora in order to promote public diplomacy[69], national branding, economic facilitation and reinforces partnership activities. Furthermore, it has the ability to host international summits on a regular basis, to work with significant think tanks and be a relevant interregional partner.

5. What conclusions are setting OBOR apart?

The belt and road iniciative was a complete new international cooperation mechanism that China suggested to international community

China Watch, 2015, page 29

Concluding, OBOR has been designed as a multipurpose, multilateral, multi actor, long-term development strategy, departing from the so-called Silk Road Spirit – "peace and cooperation, openness and inclusiveness, mutual learning and mutual benefit"[70]. As Thomas Chan (2016, page 19)[71] mentioned, its ultimate goal is to transform the world political and economic regime from a single hegemony, to a multi-polar systems, to provide more space to the development of China together with others, leveraging China strengthen and influence in global economic and political affairs. OBOR must be completed by the DEA and SEA as a part of the *Chinese Grand Strategy*, which will bring the Middle Kingdom to the centre of the global chessboard. Undeniably, the world will be a different place due to the current Chinese plans to transform worldwide flows of interconnectedness and this fact will trigger consider interregional structural transformation. Fernanda Ilhéu (2016, page 17)[72] acknowledged that OBOR brings a "new globalization dynamics able to transform the world". Definitely, modern China is entering in a phase of national renewal and reform to change its production paradigm based on the

[68] Francisco Leandro (2016). MSAR and EU two subjects of international law? Rui Cunha Foundation, IEEM and Orient Foundation.
[69] The 1st Lusophony Games stands as a very good example because they were hosted by MSAR, from 7 to 15 October 2006.
[70] Vision and Actions on Jointly Building Silk Road Economic Belt and 21st Century Maritime Silk Road (2015/03/28), Issued by the National Development and Reform Commission, Ministry of Foreign Affairs, and Ministry of Commerce of the People's Republic of China, with State Council authorization, paragraph I. Retrieved July 4, 2016, at http://en.ndrc.gov.cn/newsrelease/201503/t20150330_669367.html
[71] Patrícia Magalhães (2016). Building the Future, Macao Magazine, May, page 19.
[72] Patrícia Magalhães (2016). Building the Future, Macao Magazine, May, page 17.

following criteria: Infrastructure, environmental sustainability, quality & competitiveness, regional stability and inclusive social responsibility.

OBOR is part of the national development strategy, supported by a network of infrastructural assets, holding the potential to resettle the pattern global commercial flows and therefore, boosts the need for further regional and inter-regional cooperation. In light of this fact, China's SAR have no alternative but to be part of **Guangdong pentagonal regional arrangement composed of Zhuhai – Guangzhou – Shenzhen – Hong Kong – Macau**, merely because it gives the right scale to Macau to engage Portuguese, Latin and African markets. **The Guangdong pentagonal regional arrangement combines the functional power of MSAR to attract all the way of the maritime Silk Road, the HKSAR to provided world-class reliable services and the Zhuhai - Guangzhou - Shenzhen area capacity to deliver mass of goods and services.** Indeed, the "big picture" of the South China region, namely the Beibu Gulf Economic Zone and the GPRDZ (as part of the PPRDA) form an important gateway connecting the Silk Road Economic Belt and the 21st Century Maritime Silk Road.

All in all, the Chinese long reach beacon gives sense and paves the way towards the future of Macau and HK SARs, as a unique non-sovereign territories, tailored to deliver social and economic expectations, and where Asian and Western civilizations truly need to endeavors. It is time to Macau and Hong Kong to join efforts acting integnated into GPRDZ to support obor. Regional and sub regional integration, differentiation, and international presence are paving the SAR way, towards an active contribution to what President Xi Jingping clearly has put forward: the renewal of the Chinese nation is the greatest 'Chinese dream (中國夢)', for the Chinese nation in modern history. Likewise, we must clearly mention that SAR's role, as it once was part of the maritime Silk Road roots, currently builds on the location of the new globalization COG. We foresee SAR acting as a non-sovereign special administrative regions as facilitators, in which MSAR is grounded on the **four pillars of functional soft power subsidiarity**, driven by Chinese sovereignty, as a natural consequence of the one country two systems principle.

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協調政策和實踐以增強粵港澳大灣區的城市及區域韌性和可持續發展

吳兆堂[1]，徐軍[2]，吳琼，邢繼鐸
香港大學土木工程系

摘要：國家推動的‘一帶一路’戰略明確要求各級政府要充分發揮深圳前海、廣州南沙、珠海橫琴等開放合作區作用，深化粵港澳台合作，推進區域重大基礎設施建設，優化區域經濟格局，構建世界級城市群，打造粵港澳大灣區。這不僅為大灣區的經濟發展帶來前所未有的歷史機遇，同時也為大灣區的可持續發展帶來重大挑戰，其中如何增強區域和城市韌性是大灣區城市必須共同面對和解決的問題，以提高應對氣候變化、極端天氣、自然災害以及其他人為破壞的能力。

本文基於政府制定公共政策參考的執政資源模型(NATO)提出了一個分析和比較城市韌性政策的基本框架。大灣區不同管理模式的城市可以使用該框架分析和比較現有城市韌性和可持續發展政策工具的不足和共同點，探討和協調增強整個大灣區城市群韌性和可持續發展的策略和路線圖，在區域和城市層面努力實現《巴黎協定》、《2015-2030年仙台減少災害風險框架》、《變革我們的世界：2030年可持續發展議程》等國際公約中達成的2015後可持續發展目標。

關鍵字：公共政策、政策工具、適應性、韌性、2015後可持續發展議程

1. 引言

自2016年4月《巴黎協定》高級別開放簽署以來，該協定已獲得包括中國在內的177個國家及地區前所未有的支持。《巴黎協定》各締約國同意加強對氣候變化威脅的全球應對，承諾2020年前把全球平均氣溫升幅控制在工業化前水平以上低於2℃之內,並努力將氣溫升幅限制在工業化前水平以上1.5℃之內。《巴黎協定》、《2015-2030年仙台減少災害風險框架》和《變革我們的世界：2030年可持續發展議程》等國際公約為各國應對預防、准備、適應和減緩氣候變化、極端天氣、自然災害和其他人為破壞所帶來的問題及影響提供了重要指導，形成了一致的2015后發展議程目標（Roberts等，2015）。議程呼籲締約國所轄各級政府制定和開發適當的韌性及適應性相關政策，通過提高現有政策的一致性或實施新的政策，利用集成政策工具，優化投資和管理，提高公眾認識，調動各界力量和資源等綜合手段來共同實現發展議程目標。

減緩氣候變化、極端天氣、自然災害及其他人為破壞所帶來的影響是人類可持續發展的一個長期目標，需要多學科知識支撐，更需要中央、地區、各級政府、當地社區、私營企業及每個人的務實行動（Angel等，2016）。近年來，世界各地已經推出多項計劃，鼓勵不同城市、次國家地區、公司、投資者及公民社會組織登記參與應對氣候變化的行動、承諾和措施，以提高各種氣候變化活動的透明度，動員更大程度的參與，并加速韌性進程。這方面的例子包括：聯合國氣候變化框架公約(UNFCCC)設立的氣候問題解決方案非國家行動者計劃(NAZCA)、洛克菲勒基金會創立的“100韌性城市網”項目、聯合國國際減災戰略署(UNISDR)發起的“讓城市韌性起來(Making Cities Resilient)”運動、C40城市氣候領袖組織、以及國際地方環境行動理事會(ICLEI) 發布的城市溫室氣體排放核算和報告通用標准—《城市溫室氣體核算國際標准》(GPC)。

國家推動的‘一帶一路’戰略明確要求各級政府要充分發揮深圳前海、廣州南沙、珠海橫琴等開放合作區作用，深化粵港澳台合作，推進區域重大基礎設施建設，優化區域經濟格局，構建世界級城市群，打造粵港澳大灣區(HKTDC, 2015)。這不僅為大灣區的經濟發展帶來前所未有的歷史機遇，同時也為大灣區的可持續發展帶來重大挑戰。其中，如何增強區域和城市韌性是大灣區城市必須共同面對和解決的問題，以提高應對氣候變化、極端天氣、自然災害以及其他人為破壞的能力。韌性城市作為一種應對這些挑戰的新的城市規劃和管理理論正被越來越多的國際城市所採納。雖然香港和深圳已加入C40城市氣候領袖組織，中國的德陽、黃石、義烏和海鹽也已成為“100韌性城市網”的成員，但韌性城市理論在國內的應用還相當有限（徐振強，2015；樊麗萍，2016），更別說大灣區城市群的區域韌性實踐。

像其他許多高密度特大城市一樣，香港已經開始引入并採取各種措施來應對氣候變化所帶來的挑戰。例如：香港正積極推動溫室氣體(GHG)減排政策，如改變當地發電的燃料結構，減少建築物和運輸業的耗能和溫室氣體排放等。另一方面，香港正提出一系列基礎設施改進計劃項目來改善其氣候變化應變能力，減低洪災風險和預防滑坡影響，增強城市韌性(HKENB, 2015a, 2015b)。

儘管世界各大城市為應對氣候變化已付出諸多努力，但在制定和實施韌性及適應性政策過程中他們仍然面臨著諸多挑戰。比如，如何實現政府機關、人員、部門之間橫向及縱向的協調；如何改善城市內部運轉效率和能力；如何示範應對氣候變化措施所帶來的益處並取得支持；如何了解利益相關者對城市韌性和適應性的認知水平和吸引他們的廣泛參與；公私營部門如何合作；怎樣獲得解決氣候問題的資助(C40 Cities, 2016)。從公共政策週期循環的角度來看，區域城市群和高密度特大城市迫切需要一個整體的政策分析工具來幫助其政策制定和決策者甄別現有政策和實踐差距，并據此制定協調一致的城市氣候適應性和韌性政策。

根據已有文獻研究，本文旨在設計一個公共政策集成開發框架以幫助區域性城市群及高密度特大城市透過適應性和韌性視角對現有政策工具和實踐進行有效實證評價評估，或制定和實施新的韌性和適應性增強措施。

本文首先介紹相關研究工作，然後基於公共政策執政資源模型NATO（Nodality（節點），Authority（權威），Treasure（財政），Organization（組織））提出了一個分析和比較城市韌性政策的基本框架。通過這個框架，粵港澳大灣區的城市可以對與可持續發展、氣候變化、城市規劃、建築環境管理、風險管理、防災減災和應急管理等密切相關的政策和實踐進行綜和分析，從而設計和實施協調統一的城市及區域氣候適應性和韌性政策。本文結論部份分析總結應用該框架的適用性和限制，以及需要進一步研究的問題，並簡述了粵港澳大灣區城市實現2015后可持續發展目標的可能性、路徑和藍圖。

2. 已有相關工作

2.1 適應性和韌性概念

近年來，適應性和韌性概念已經引起世界各地的政策制定者、政府當局、從業者以及科學家的重視。他們希望能藉此概念來應對由不可預知的氣候變化、極端天氣、自然災害和其他人為破壞性活動(包括：自然災害、網絡事件、工業事故、傳染病，恐怖襲擊和破壞性的犯罪活動等)所帶來的挑戰和風險。適應性是指為了應對預期或實際的破壞性事件及其造成的損失，或因氣候變化帶來的後果，生態、社會、技術和經濟系統的自我調節能力或藉機受益的能力(UNFCCC, 2015; UNISDR, 2009)。由聯合國和美國國家研究委員會定義的韌性，是指一個系統、組織、區域或城市等及時有效地抵御、吸納、承受和適應災害的影響，並從中恢復的能力，包括保護和修復必要的基礎设施及其功能(NRC, 2012)。

近年來，國家層面或面向特別領域的適應性和韌性政策框架陸續頒布，如美國的PPD-21計劃、EO-13636計劃和NIPP計劃(NIAC，2014)和澳大利亞的國家災難恢復策略(Morley等, 2015)。在本地政府或城市層面，洛克菲勒基金會從數以百計的城市中遴選出100個城市加入其"100韌性城市網"(www.100resilientcities.org)。在美國，已有超過40個社區創建其獨立的氣候適應性計劃(Woodruff & Stults, 2016)。美國韌性圓桌會議和區域化韌性組織同時也在幫助當地社區通過各種試點項目和信息技術系統加強其應對人為破壞、自然災害和極端天氣的韌性。在亞洲，2008年啟動的"亞洲城市應對氣候變化彈性網絡"旨在幫助亞洲城市提高其應對氣候變化的韌性 (acccrn.net)。

將一個區域、城市或社區視為一個有著清晰地理邊界及政府結構司法權的系統，其通常由多個個體、組織、基礎設施和功能服務模塊或社區資本(如：自然、物質、經濟、人力、文化、政治和社會資本)組成 (Flora等, 2016)，一個通用、系統化、多範例化的公共政策開發框架對擁有不同管理模式的區域性城市群及地方政府設計和實施一致的橫向和縱向適應性和韌性政策來說必不可少(Dow等, 2013; Erisman & Ciais, 2015)。

2.2 聯合國2015後發展議程

因三個備受關註的國際政策進程被很多國家認可，2015年成為全世界可持續發展進程的里程碑。這三個進程包括：(1) 2015年9月被採納的《變革我們的世界：2030年可持續發展議程》(UNGA,2015a)；(2) 2015年3月被采納的《2015-2030年仙台減少災害風險框架》(UNGA,2015b)；以及(3) 2015年12月在巴黎聯合國氣候變化框架公約第21次締約方會議中建立的《巴黎協定》(UNFCCC,2015)。這三個進程為各國應對氣候變化、極端天氣、自然災害和人為破壞等挑戰提供了全面的指南和目標，因此也被統稱為聯合國2015後發展議程(Roberts et al. 2015)。

《變革我們的世界：2030年可持續發展議程》中，包含了17個方向性目標以及169個可以為國際可持續發展提供有用指導的具體子目標，例如監測策略以及包含環境、社會和經濟三方面要素的超平衡可持續發展維度模型。該議程中的很多具體目標都和環境變化息息相關。除此之外，近30個具體目標(如SDG 9、SDG 11b和SDG 13)與災難風險降低、氣候變化韌性以及社區韌性有著直接或間接的聯系(UNGA,2015a)。

《2015-2030年仙台減少災害風險框架》中囊括了7個全球化目標，4個首要任務和一系列在未來15年減少災害風險和脆弱性及提高應變能力的指南。該框架旨在減緩因自然或人為破壞事件造成的風險和損失。為了有效降低和防止關聯災害發生的風險以及減少相關事件發生和應對過程中的不確定性，該框架建議各成員國開發并採用綜合性多災害應對措施，包括：風險知情決策過程、利益相關者參與合作夥伴關係模型、開放的信息共享機制、和以科學知識和技術(如社交媒體、移動技術、大數據等新興信息技術)為基礎的知識共享、信息交換和運用機制及工具(UNGA,2015b)。

《巴黎協定》力求通過各締約國確定的國家級減排目標體系(各國自願減排貢獻)來大幅削減全球溫室氣體排放，以加強全球應對氣候變化的反應能力。該協定旨在建立減緩適應和損失及破壞之間的聯繫；培養和提高韌性能力；提高迅速適應氣候變化的不利影響的能力；減少溫室氣體排放；及共建低碳社會和低碳經濟體系等(UNFCCC, 2015)。

在聯合國2015年后發展議程下，這三個議程為全球可持續發展提供了全方位指南。而實現這些議程目標的關鍵就是，各級政府和社區要協調制定和實施各項公共政策，把發展和提高城市和區域適應性及韌性的各項要素凝聚起來，轉變和創新應對方式，共同實現目標，共禦風險和共享發展成果。

2.3 公共政策循環及NATO框架

公共政策可被定義為"一個政府當局選擇是否有所作為以解決既定問題或相關問題的過程"，其通常由交織在一起的一組元素組成，如：問題、目標、手段、工具、行為者、行動主體和部門等(Leslie,2014)。政策決策通常被視為一個利用各種工具解決問題的流程或循環，一般包含五個關鍵階段：議程設置、政策制定、政策決策、政策實施和政策評估。政策手段或者政策工具通常指的是政府在政策循環的各階段對個人、組織或其他行動主體採取的技術和行為干預，以達到既定政策目標(Michael, 2011)。

政府可以在政策循環的任一階段利用多種資源或工具來制定、執行、評估政策手段以實現政策目的。NATO是一個可以用來歸類這些政府資源的通用框架(Hood & Margetts, 2007)。

"Nodality(節點)"意味著政府是信息、社會和政治網絡的中心。為達政策目標，政府將採取積極行動，如通過教育改善公民行為。"Authority(權威)"意味著政府可以藉由政府權力通過法定方式，對目標人群發起許可、禁止或行動指令。"Treasure(財政)"指的是政府可以採用貨幣資源和財政激勵措施，如資金和稅收，維持公共產品和福利，誘導目標群體改變行為，以達至政策目標。"Organization(組織)"賦予政府直接採取行動以實現政策目標的權利(例如動員員工或利用政府採購能力)。

基於政府利用NATO資源的方式，如用探測器收集信息或利用效應器影響外界，政策手段和工具可被分為不同的類別。此外，分析和校準不同的政策工具組合還需要參照政策工具評估原則，如自動性、可見性、干涉性、成本以及目標精準度等。針對不同的政府管理模式、政策環境和政府可用資源，公共政策工具的選擇或有差異(Michael, 2011)。

3. 適應性和韌性政策分析集成框架

雖然聯合國2015後可持續發展議程在國際層面對各締約國的適應性和韌性政策規定了目標和指標，但各區域、各級政府和城市仍需根據各自社區資本特點頒布和實施本地化的政策工具，校準和協調相關承諾及活動，才能得以真正實現這些目標。本文設計了一個基於NATO政策模型的城市或區域適應性和韌性政策分析框架(簡稱FARP)，以期能協助粵港澳大灣區城市和政府從適應性和韌性角度比較和分析現有相關政策工具或頒布和實施新政策，以增強整個區域應對氣候變化、極端天氣、自然災害以及其他人為破壞適應能力和韌性。

如圖一所示，政策分析框架FAPR包括9個主要步驟：(1)根據聯合國2015後日程訂立本區域或城市的適應性和韌性政策目標；(2)從現有政策或實踐中篩選出適應性和韌性相關的部分；(3)根據NATO模型對篩選出的政策和實踐進行分類；(4)定性評估和比較已經分類的政策工具和實踐；(5)評估城市的氣候變化、社會和自然災難的適應性和韌性能力；(6)運用系統模型對不同政策工具選項可能產生的結果進行全面評估和分析；(7)決策行動或不行動方案；(8)執行更新或頒佈新政策；(9)根據政策執行情況和反饋，跟蹤、評估和校準政策工具手段，持續改進。將一個社區、一個城市或一個區域(比如：粵港澳整個大灣區)看做一個社會技術系統，該政策分析框架能夠集成政策循環的各個階段以及城市韌性和適應性的各個動態迭代過程，協助相關持分者制定和實施協調統一的適應性和韌性公共政策。

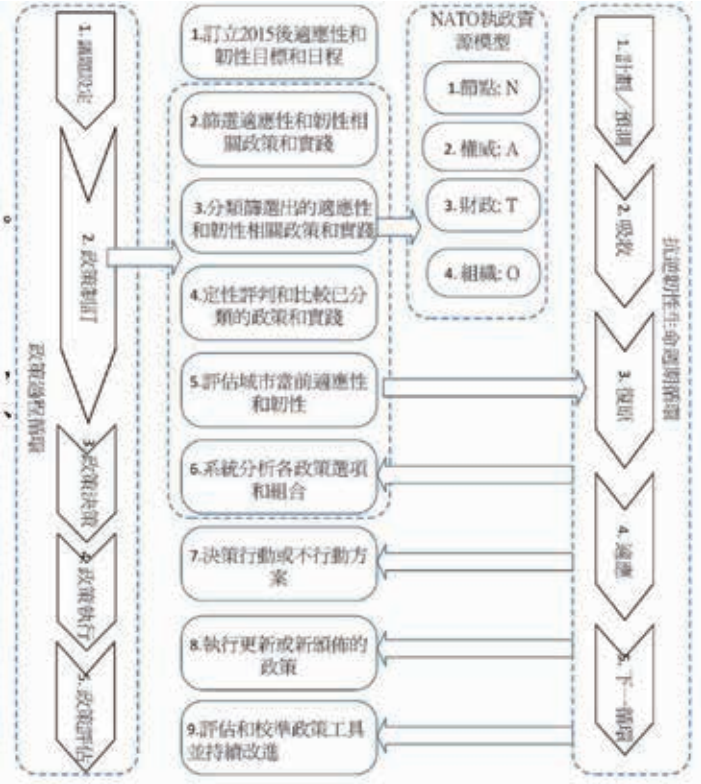
(1) 訂立2015後適應性和韌性目標和日程：全球層面的2015後適應性和韌性政策議程和目標已經通過聯合國有關可持續發展、減少災害風險和應對氣候變化等議程協同確立。發達和發展中國家中的各地方政府、州、地區和城市應當根據他們所屬國的相關承諾訂立本地政府或城市的目標和日程，最大限度適應或減低氣候變化、自然災害或人為破壞帶來的損失和負面影響。

（2）篩選適應性和韌性相關政策和實踐：根據不同的社區資產維度（例如：環境、物質、文化、財務、人力、政治和社會）（Flora等，2016），從各政府部門和機構蒐集現有政策和實踐，然後篩選出符合適應性和韌性相關原則的部分。

（3）分類篩選出的適應性和韌性相關政策和實踐：將選出的政策工具和實踐按照NATO維度和社區資產維度或不同政府管理界別（如：水、交通、建築、能源等）組織成分類矩陣圖。

（4）定性評判和比較已分類的政策和實踐：通過已經建立的政策分類矩陣圖的稀疏程度，各持份者不難觀察到不同適應性和韌性政策工具及實踐之間的依賴性、相互依存關係和間隙。不同城市、區域或政府部門之間的政策實踐差異也可以通過多個政策分類矩陣圖之間的差異構建。若賦予不同政策工具之間的交互關係不同量化指標，政策分類矩陣圖更可以幫助各持份者綜合考量和協調各項政策工具，確定優先次序，並做持續跟進和優化。

（5）評估城市當前的氣候變化、社會及自然災難的適應性和韌性：將一個城市或區域看做一個社會技術生態系統或多個子系統構成之複雜系統，其韌性能力可以從多個視角來評判，如：一個城市對自然災害和人為破壞災難的監控、反應、預見和學習能力 (Hollnagel, 2014)。客觀評判需要一組完善一致的度量指標體系，同時各持份者可以憑藉這套體系監督和跟進一個城市的韌性發展進程。而設計這樣一套體系極具挑戰，因為這不僅需要一致的定性和定量指標，更需要可靠的數據和算法來計算這些指標 (NRC, 2012)。此外，不同社區資本之間的依賴關係、不同政策工具的交互關係、氣候變化和災難災害發生的不確定性和級聯效應也是在評估城市適應性和韌性能力時需仔細考量的關鍵因素。



圖一、區域和城市適應性和韌性政策分析框架FARP

（6）運用系統化模型全面分析各政策選項和組合：目前有很多用於政策分析的模型和工具，如：投入產出分析、博弈論、成本效益分析、計量經濟模型、優化理論、系統動力學、基於個體建模和複雜網絡模型等。當今社會愈來愈多元化、開放、全球化和網路化，政策制定者及其他持份者只有綜合利用這些政策工具才能對不同政策工具組合以及這些政策的實施可能對整個社區或城市帶來哪些影響做出客觀評判。最近的一些政策決策工具，如預測-行動方法、預期成效評估法、場景分析、探索式建模和分析、動態自適應方法等，可以用來處理和模擬各種政策組合的不確定性和複雜性(Walker等, 2013)。

FARP框架中的步驟7、8、9是一般公共政策開發週期的標準階段，感興趣的讀者可以參考政策科學相關文獻閱讀詳細內容（Michael, 2011）。

4. 粵港澳大灣區適應性和韌性政策分析

根據已出版的相關文獻及政府工作報告，我們使用本文提出的適應性及韌性政策分析框架(FARP)比較分析了粵港澳大灣區的城市和區域韌性政策，初步分析結果如下：

(a) 粵港澳大灣區的省市在應對氣候變化、提高城市適應性和韌性方面已出台諸多政策和開展相關行動(HKENB, 2015a, 2015b; 徐華清, 2015)。 以社區資本類型和NATO範式為維度，這些政策和行動可以組合成二維矩陣圖，分別見表一、二、三。

(b) 廣東省正充分發揮規劃和政策引導作用，積極開展國家低碳省區和低碳城市試點、國家碳排放權交易試點，探索構建多層次的低碳試點網絡，加強溫室氣體統計核算等能力建設，努力創新低碳發展路徑和機制。但廣東省還沒有出台有針對性的區域或城市韌性相關政策和開展相關實踐。

(c) 香港已經認識到加快氣候變化行動的重要性，並正採取多方面措施減少溫室氣體排放，務求達致於2020年把碳強度由2005年水平減少50％至60％的目標。此外，香港已經成立一個由政務司司長主持的跨部門委員會，督導和統籌各決策局和部門的有關氣候行動，制定香港的長遠氣候策略和2030年減少碳排放的目標，為中國落實《巴黎協定》積極做出貢獻(LEGCO, 2016)。

(d) 廣東、香港和澳門的城市適應性和韌性相關政策和實踐大多由政府部門驅動和主導，大多集中在物質資本領域。將粵港澳大灣區視為一個系統或整體，需要其他社區資本領域的適應性和韌性政策和實踐，以進一步增強整個區域的韌性和適應性。

表一：廣東省現有適應性和韌性相關政策和實踐

NATO / Capital	Nodality / Information (節點／信息)	Authority (權威)	Treasure (財政)	Organization (組織)
Natural 自然	[illegible]	[illegible]	[illegible]	
Cultural 文化	[illegible]			
Human 人力				
Social 社會	[illegible]			[illegible]
Political 政治	[illegible]			[illegible]
Financial 經濟	[illegible]	[illegible]	[illegible]	[illegible]
Built 物質	[illegible]	[illegible]	[illegible]	[illegible]

表二：香港現有適應性和韌性相關政策和實踐

NATO / Capital	Nodality / Information (節點／信息)	Authority (權威)	Treasure (財政)	Organization (組織)
Natural 自然			Revamping fuel mix	
Cultural 文化				
Human 人力				
Social 社會				
Political 政治				Steering Committee on Climate Change
Financial 經濟			(1) Green Transport Fund; (2) Building Energy Efficiency Fund Scheme	
Built 物質	(1) Energy Saving Plan for Hong Kong's Built Environment 2015 ~ 2025+; (2) Post-COP21 Green Building Imaging session; (3) Energy Saving for All campaign; (4) consultancy study on sea level rise; (5) Hong Kong 2030+: Towards A Planning Vision and Strategy Transcending 2030; (6) weather warning and alert system; (7) early storm surge alert systems; (8) BEAM Plus rating; (9) carbon labelling for construction products	(1) Building Energy Efficiency Ordinance; (2) Building Regulation; Energy Efficiency Ordinance	(1) Energy audits and energy saving practices for government buildings; (2) extend rail network and prioritize public transport; (3) promote energy efficient vehicles; (4) implement waste reduction, reuse and recycling plans; (5) build new waste treatment facilities to recover energy; (6) Landslip Prevention and Mitigation Programme; (7) drainage master plan and improvement works	(1) Energy audits and energy saving practices for government buildings and public estates; (2) Contingency Plan for Natural Disasters; (3) Inter-departmental Task Force on Emergency Preparedness; (4) Headquarters Emergency Coordination Centre of Home Affairs Department and District Emergency Coordination Centres

(e) 從已出版的政府報告可以看出，粵港澳大灣區的城市適應性和韌性方面的政策和實踐集中在減少溫室氣體排放、減緩氣候變化、適應氣候變化和加強氣候應變能力等幾個方面(LEGCO, 2016)。然而，各界和持份者仍未就以上概念達成一致認識，普通市民的認知仍有待提高。該地區各城市仍缺少一套一致的量化度量標準來評估、監控、跟蹤和提高整個城市的氣候變化適應性和韌性。

(f) 桌面研究顯示，運用系統化模型來分析粵港澳大灣區各城市及整個區域的適應性和韌性政策和實踐方面的研究仍十分有限。

(g) 粵港澳大灣區的城市適應性和韌性政策和實踐不應侷限於各國承諾的《巴黎協定》中的條款和要求，而應以聯合國2015後可持續發展目標和規劃為標竿，設定和實施適合自身的目標和發展路線圖。

(h) 粵港澳大灣區實現聯合國2015後可持續發展目標的進程仍處於初級階段。因此，制定全面的城市適應性和韌性政策，開展協調統一的行動，社區、各政府部門、非政府組織、私營企業和大眾市民的教育、參與和合作非常關鍵。

5. 結論

粵港澳大灣區的各城市迫切需要協調制定適合各自特點的城市適應性和韌性政策，以應對氣候變化、自然災害和人為破壞可能帶來的損害和損失，並滿足聯合國設立的2015後可持續發展目標。本文提出了一個基於政策開發模型NATO的城市適應性和韌性政策集成開發框架。使用這個新提出的框架，本文比較分析了粵港澳大灣區幾個城市(香港、澳門、廣東)的氣候變化和可持續發展政策、各城市適應氣候變化的能力、以及各城市增強城市韌性的方法。初步的研究結果表明，粵港澳大灣區各城市缺乏成熟的協調機制、政策和實踐，以增強整個粵港澳大灣區的區域韌性。 本文提出的框架能夠協助這些城市或各級政府部門研判現有政策和實踐的不足，並設計新的協調統一的適應性和韌性政策工具。

表三：澳門現有適應性和韌性相關政策和實踐

NATO / Capital	Nodality / Information (節點／信息)	Authority (權威)	Treasure (財政)	Organization (組織)
Natural 自然				
Cultural 文化				
Human 人力				
Social 社會				
Political 政治				
Financial 經濟				
Built 物質				

為提高本文提出的用以制定城市及區域韌性政策的框架的實用性，仍需繼續以下幾方面的研究，包括但不限於：(1)基於多系統模型的政策分析工具；(2)韌性及適應性定性、定量評估方法和度量指標；(3)評估韌性及適應性所需的數據規範；(4)城市韌性和適應性評估和管理信息系統。

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“一帶一路”與香港經濟第三次轉型
‘One Belt and Road’ and the Third Economic Transition of Hong Kong

毛艷華
中山大學／粵港澳發展研究院
廣東廣州／中國

榮健欣
中山大學／港澳珠三角研究中心
廣東廣州／中國

新世紀以來，香港經濟進入了第三次轉型時期。從經濟發展和產業結構變動的特徵來看，香港經濟第三次轉型主要發生在服務業內部，並進一步呈現出經濟服務化趨勢、主要行業向高增值環節轉型升級和經濟功能向離岸服務角色演變等三方面特徵。在內地加快構建開放型經濟新格局的背景下，“一帶一路”建設機遇能够不斷强化香港作為亞洲乃至全球價值鏈管理樞紐的地位，將為香港成功實現第三次經濟轉型提供巨大動力。因此，“一帶一路”建設與香港經濟的長遠發展戰略相一致，香港應積極主動參與“一帶一路”建設。

Since the beginning of the 21st century, Hong Kong’s economy has been undergoing the third transition. From the perspective of economic development and industrial restructuring, Hong Kong’s service sector is the main theater of the transition. In the transition, Hong Kong’s service sector become more important, its main industries are being upgraded to high value-added segments and its economic function are being transformed to offshore service. With Mainland China accelerating its speed in building a new open economic system, the Belt and Road Initiative will provide new opportunities for Hong Kong to strengthen its status as the managerial center of Asian and global value chain, and will be of great help for Hong Kong to succeed in its third economic transition. Therefore, the Belt and Road Initiative is in accordance with Hong Kong’s long term economic development strategy, and Hong Kong should actively participate in the Belt and Road initiative.

1. 序言

香港土地面積狹小，自然資源貧乏，屬?典型的城市經濟體，其經濟發展受制于外部市場環境的變化，並因應外部市場機遇推動自身經濟發展的轉型，尤其是中國內地的情勢是其經濟轉型的關鍵因素。回顧上世紀50年代初期，在朝鮮戰爭和對華禁運的國際形勢下，香港抓住全球產業轉移的機遇，走上工業化發展道路，逐漸成為全球主要的輕工產品供應地，實現了第一次經濟轉型，由以轉口貿易為主的自由港轉變為以港產品出口為主的自由港。在70年代，香港生產成本快速上升，恰逢1978年中國內地推行改革開放，為香港製造業提供了北上投資設廠的機會，香港也成為世界通往內地的主要門戶，貿易與投資業務不斷增長，香港外貿中的轉口貿易又逐步恢復，香港由此實現了第二次經濟轉型，轉變為以服務業經濟為主的自由港。

進入新世紀後，隨著內地尤其是珠江三角洲地區的港口基礎設施逐漸完善，加上中國內地于2001年12月加入世界貿易組織，承諾逐漸開放貿易服務。因此，就如製造商在80年代一樣的情況，香港服務供應商也把其業務範圍擴展至內地尤其是珠江三角洲地區，與內地建立了服務業的分工合作關係。在內地的貿易支援服務業獲得發展的情況下，離岸貿易逐漸成為香港的主要貿易形態。在離岸服務模式下，香港的金融、貿易和專業服務等主要行業在全球價值鏈中占據著重要位置，扮演著供應鏈管理、整合和優化的角色。因此離岸服務模式促進了與貿易有關的服務外包和集成，推動香港服務業向高端和高增值環節轉變。伴隨著經濟第三次轉型，香港的整體競爭力大為提高，作為亞太地區首要貿易樞紐的地位不斷鞏固。

黨的十八屆三中全會《決定》提出了構建開放型經濟新體制，包括新的開放形勢下實施“走出去”戰略、自由貿易區戰略和“一帶一路”戰略。在改革開放30餘年的進程中，香港經濟與內地經濟已形成了緊密的分工協作關係，因此，開放型經濟新格局的構建必然重塑香港與內地的經貿合作關係。“一帶一路”建設機遇能够不斷强化香港作為全球價值鏈管理樞紐的地位，助力香港成功實現第三次經濟轉型。下文首先就新世紀以來香港經濟第三次轉型的特徵與方向進行探討，然後分析“一帶一路”建設對香港加快實現經濟轉型升級的可能機遇與動力方向，最後提出香港參與“一帶一路”建設推動第三次經濟轉型的具體途徑。

2. 香港經濟第三次轉型的特徵與路向

就經濟學的基本理論來看，經濟轉型與經濟體的發展模式和產業結構的轉變有關，實質上是經濟發展方向的問題。從新世紀以來香港經濟發展和產業結構變動的特徵來看，香港經濟第三次轉型主要發生在服務業內部，進一步呈現出經濟服務化趨勢、主要行業向高增值環節轉型升級和經濟功能向離岸服務角色演變等特徵。具體體現在自2000年以來香港各行業在整體經濟活動中的占比、各行業的勞工生產力年均增長率和貿易結構變化等指標上。

2.1 新世紀以來香港經濟服務化現象日趨明顯

一方面，製造業在香港經濟活動中日漸萎縮，服務業在香港經濟活動中已占絕對優勢。從附錄表1中可以看出，在2000年香港製造業占GDP比例為4.8%，到2014年下降為1.3%，在香港經濟中的地位每況愈下。相反，服務業的比重則從2000年 的87.3%上 升 到2014年 的92.8%。 當然，單從GDP中製造業和服務業的占比來看，這種變化趨勢在上世紀80年代以來香港第二次經濟轉型中已經出現了。也即從港產品出口為主的自由港轉變為服務業經濟為主的自由港過程中，服務業占比已不斷上升，如香港在1997年回歸時服務業占比已達到85%。

另一方面，香港服務業內部結構正在加快調整，知識服務業的比重不斷上升。這正是自新世紀以來香港第三次經濟轉型的經濟服務化內涵與第二次經濟轉型大不一樣的地方。從附錄表1中服務業內部各經濟活動在GDP的占比變化可以看出，金融及保險業的增加值占GDP比重 從2000年 的12.8%上 升 到2014年16.6%； 專業及商用服務從2000年的4.2%上升到2013年的5.7%；信息及通訊業從2000年的3.3%上升到2014年3.5%；而公共行政、社會及個人服務的增加值占比一直維持在較高的比重。根據OECD對知識產業的劃分，金融保險及其它商業服務業，通訊服務業，社區、社會及個人服務業，這三個行業類型都屬?知識產業。在服務業內部的其它行業中，傳統的地產業占GDP的比重基本在5%左右，與1994年達到11%的創紀錄占比已有很大的下降幅度；傳統的進出口貿易服務作為香港的支柱產業仍然占有重要的地位，但運輸及倉庫服務業在GDP中的占比有明顯地下降，從2000年7.2%下降到2013年的5.7%，顯示出香港轉口貿易的功能正在轉變；住宿及膳食服務和批發及零售業可以看作旅游相關產業，前者在GDP的占比從2000年的2.9%上升至2014年的3.6%，後者從3.3%上升至5.3%。總體上看，在香港第三次經濟轉型中，知識服務業和旅游業的比重不斷上升，而傳統轉口貿易相關行業以及與地產有關的服務地位有明顯下降。

2.2 主要行業向高增值環節轉型升級

附錄表2為2001年以來香港主要經濟活動的勞工生產力指數變化情況。勞工生產力指數的計算方法是將實質生產指數除以勞工投入指數。它顯示勞工投入如何有效地運用在實質生產中。一般來説，引致勞工生產力指數變動的因素包括科技、機構架構、管理方法、資產等的改變。從附錄表2可以看出，2001年至2014年，香港整體經濟活動的勞工生產力指數呈不斷上升趨勢，2014年是2000年的1.5倍。在選定的主要經濟活動中，無論是製造業和傳統的進出口貿易業，還是現代金融業和保險業，各行業的勞工生產力指數都有明顯的提高。除了製造業和

住宿膳食服務業外，其它選定行業的勞工生產力指數的增長都要高于整體經濟活動的表現，這説明香港經濟正在向高增值服務業轉型。

根據哈佛商學院波特(Micheal E. Porter)教授有關經濟體競爭力的理論，一個經濟體的經濟將遵循要素驅動、投資驅動、創新驅動三個階段演進發展。[1]香港在波特模型中是屬進入創新驅動階段的經濟體，也就是説應通過科技創新與新技術應用來推動各行業向高增值和高附加值方向發展。香港的高科技開發能力雖然較弱，但對高科技產品的接納和運用却是一個强項。例如，香港在基礎設施建設、資訊處理效率、資訊技術普及率等方面都十分先進，這些都有助于推動各經濟活動向高增值服務業轉型。從行業或企業經營的層面看，1997年亞洲金融危機暴發後，經濟不景氣推動了企業采用新科技及重組營運模式，有助于提升企業及整個行業的效益與素質。

2.3 主要經濟功能向離岸服務角色演變

新世紀以來，香港轉口港功能開始轉型，離岸貿易超過轉口貿易，成為最主要的貿易形態。附錄表3列出了2002年以來各年度香港主要貿易形態貨品值及其年變動率情況。可以看出，港產品出口總體呈現快速下滑的態勢，由2002年的1309.26億港元下降到2013年543.64億港元，在香港整體對外貿易中已處于無足輕重的地位了；轉口貿易雖然從2002年的14295.9億港元增加到2013年的35053.22億港元，年均增長率達到7.76%，但近年來增長十分緩慢；相反，離岸貨品貿易却從2002年的14582.52億港元增加到2013年的49543.94億港元，年均增長率達10.73%。

自2002年離岸貨品貿易首次超過轉口貿易量之後，香港貿易功能開始發生實質性的轉變，香港整體經濟功能逐漸轉變成為一個亞太貿易樞紐和運營中心。由于離岸貿易相關的服務占香港服務貿易的三分之一，離岸貿易的崛起直接帶動了香港服務貿易的增長。從2002年到2013年，香港服務輸出年均增長10.01%，大于同期商品出口和轉口貿易的7.11%和7.76%的增速。服務輸出與商品出口之比，由2002年的0.16升至0.22。香港作為一個傳統的轉口港，服務貿易的快速發展與新世紀以來這種貿易功能的轉型具有密切的關係。

綜上所述，新世紀以來香港第三次經濟轉型的特點與路向表明，香港經濟日趨服務化、多元化與高端化。具體地講，金融、保險、專業服務等知識型生產性服務業以及旅游業獲得了快速發展，傳統的進出口貿易仍然是重要的經濟行業，知識密集型的現代消費性服務業(包括社會服務業和個人服務業)成為香港經濟中充滿活力的產業，香港主要經濟活動都朝向高端和高增值環節轉變。這些轉變符合香港作為城市經濟體的傳統優勢和比較優勢，也與紐約、倫敦等"世界城市"的主導產業相一致。

從外部環境來看，新世紀以來香港第三次經濟轉型的主要動力仍然來自于內地。2001年中國加入WTO後，內地經濟和貿易的快速增長為香港的知識服務業發展提供了廣闊的市場和無限的機遇，推動了香港由轉口貿易形態向離岸貿易形態的轉變。在離岸貿易模式下，香港的金融、貿易和專業服務等行業獲得了更大的服務市場，離岸貿易的持續增長進一步擴展了香港其他服務出口，推動了香港成為亞太地區重要的貿易樞紐和運營中心。

3. "一帶一路"建設為香港第三次經濟轉型提供了新動力

長期以來，香港在內地的改革開放進程中扮演著十分重要的角色，發揮著貿易與投資的紐帶作用，並從中獲得了自身經濟增長和轉型的動力。共建"一帶一路"是中國版的全球化戰略與方案，將對全球區域合作和全球經濟治理產生深遠的影響。社會各界對香港在"一帶一路"建設中的角色與地位進行了廣泛的研討。比如，在2015年博鰲亞洲論壇上舉行的"'一帶一路'：

[1] 《創新驅動是事關我國長遠發展的核心戰略》，《光明日報》，2016年5月30日。

跨國公司的機遇與香港的角色”分論壇中，香港特別行政區行政長官梁振英認為，在“一帶一路”的戰略中香港將扮演“超級連接器”的角色，為21世紀海上絲綢之路的發展提供很多的幫助。[2]“一帶一路”建設將為香港當前的第三次經濟轉型提供新動力，香港必須抓緊這個契機，鞏固貿易樞紐的地位和運營中心的角色，推動經濟持續增長。

3.1 香港在“一帶一路”建設中具有不可替代的優勢與角色

內地在經歷改革開放30餘年的總速增長後，國內外經濟條件與發展環境發生了很大變遷，經濟進入新常態，中國經濟全球化的內涵也發生了深刻變化。提出共建“一帶一路”就是要與周邊和沿綫國家或經濟體加强基礎設施的互聯互通，深化區域貿易投資便利化，從而更好地實施“走出去”戰略和人民幣國際化，推動國內經濟結構調整和提升參與全球經濟治理能力。儘管廣州、深圳以及更多內地城市的經濟總量已經或正在趕超香港，但香港在國家發展全域中的特殊地位、對國家推進改革開放和現代化建設的特殊作用，仍將是內地任何一個城市都無法取代的。這首先是因為在“一國兩制”下香港將長期實行與內地不同的社會制度，兩地包括經濟政策和制度的差异將長期存在。二是香港的國際金融、貿易、航運等中心地位是長期形成的，也是多種因素綜合作用的結果，這些因素仍在起作用。三是香港在營商環境方面仍具有許多優勢，包括法治成熟、經濟高度自由開放、基礎設施完善、金融體系穩健、專業服務發達、政府廉潔高效、社會管理先進、低税制和簡單税制等。四是香港國際化程度高，跨國公司總部雲集，國際商業網絡發達，具有多語言交流的優勢。因此，在推進“一帶一路”建設中，香港具備全面服務“一帶一路”國家戰略的獨特能力和優勢，應繼續發揮好香港在國家構建全方位對外開放新格局中的橋梁和紐帶作用。

3.2 “一帶一路”建設與香港經濟的長期發展戰略相一致

“一帶一路”貫通亞、歐、非多個經濟圈，沿綫多為新興經濟體和發展中國家，市場潛力巨大，基礎設施“互聯互通”、區域經貿合作、資金融通和人文交流等都為香港優勢服務業的發展創造了巨大市場空間。例如，基礎設施互聯互通是“一帶一路”建設的優先領域，基礎設施建設會延伸至相關行業，涉及投資和工程承包及相關的服務需求，其中融資、項目風險、質量管理等領域將為香港帶來更多發展空間。在內地企業“走出去”投資的過程中，海外投資及並購活動增加，將帶來對香港相關的專業服務需求，香港作為內地企業“走出去”平臺的角色也將得到進一步突顯。“一帶一路”建設過程中，內地與沿綫相關國家之間的人員往來、國際物流需求等都會增加，香港作為貿易樞紐的地位和功能可得到進一步發揮，推動各類離岸業務的發展。“一帶一路”建設也為香港金融業提供了更大的服務空間，包括集資、融資、債券、資產管理、保險、人民幣離岸業務等，有利于進一步强化香港作為人民幣離岸中心的角色。另外，“一帶一路”建設有利于擴大沿綫經濟體的人文交流，香港作為全球重要的旅游城市和中西方文化交流中心，能够更好地發揮人才交流/培訓平臺的角色。

總體上看，“一帶一路”建設能够大大拓展香港離岸貿易相關服務的市場空間，解决香港高端知識服務業發展的市場瓶頸，為香港金融服務、貿易服務和專業服務等支柱產業向高增值環節的轉型升級提供機遇。因此，“一帶一路”建設與香港經濟發展的長遠戰略目標相一致，將為香港成功實現第三次經濟轉型提供巨大動力，不斷强化香港作為亞洲乃至全球價值鏈管理樞紐的地位，助推香港經濟實現第三次轉型。

[2]《梁振英：香港在一帶一路戰略中角色很重要》，
http://finance.ifeng.com/a/20150327/13588972_0.shtml

4. 香港參與“一帶一路”建設的具體路徑設計

在國家“一帶一路”建設中，香港應找到自身優勢和國家發展戰略的結合點，做好參與“一帶一路”建設的頂層設計，通過主動參與“一帶一路”建設推動自身經濟的轉型。具體來講，應根據國務院授權國家發展改革委、外交部、商務部三部委聯合發布的《推動共建絲綢之路經濟帶和21世紀海上絲綢之路的願景與行動》，分析探討香港參與“一帶一路”建設的可能路徑。總體上看，香港作為自由港和國際金融中心、國際貿易中心和國際航運中心，上述各項優勢可以全面對接“一帶一路”建設中的政策溝通、設施聯通、貿易聯暢、資金融通和民心相通五個重點領域的合作內容。

第一，在政策溝通方面，香港應發揮“一國兩制”的制度優勢充當國際聯絡平臺的角色，通過舉辦“一帶一路”相關會議、展覽、協作談判、交流對話等，為沿綫各國尋求經濟發展戰略和對策、共同制定推進區域合作的規劃和措施以及共同為務實合作推進大型項目實施提供政策諮詢支持，這有助于香港高端專業服務的發展。

第二，在基礎設施互聯互通方面，作為國際航運中心，香港的港口運營商在碼頭設計、航運調配和國際物流等方面擁有豐富的經驗；香港機場管理局在機場設計、航班管理和高效運作等服務模式具有國際一流水平。發揮這些優勢助推內地高端裝備製造企業“走出去”，共同為沿綫國家或地區的基礎設施建設提供一攬子解決方案，共同服務于“一帶一路”建設的基礎設施“互聯互通”。在這一過程中，香港可以扮演總部基地的角色，成為“一帶一路”業務的管理和運營中心。

第三，在貿易暢通方面，香港擁有的與國際通行規則相銜接的投資貿易規則體系，可以服務于“一帶一路”沿綫國家或地區的貿易便利化能力建設，而香港貿易發展局、香港生產力促進局等半官方機構和會計、審計、商業管理、法律服務等行業聚集的大量高端國際化人才可以對接內地廣大中小企業對外投資中有關金融、基建、商貿等各方面的具體需求，共同開拓“一帶一路”沿綫的國際市場。這有利于强化香港作為全球供應鏈管理中心的角色。

第四，在資金融通方面，發揮香港國際金融中心和全球第一大人民幣離岸中心的優勢，積極參與人民幣有關的基礎設施建設融資、企業股權融資市場、項目投資風險管控，為“一帶一路”建設提供融資、交易支付、貿易結算，助推人民幣國際化。另外，香港擁有强大的人民幣債權交易服務能力，可以服務于亞投行的基建基金和400億的絲綢之路基金的商業化運作。“一帶一路”沿綫金融業務的市場拓展有助于鞏固香港的人民幣海外中心地位。

第五，在民心相通方面，由于“一帶一路”沿途屬典型的多類型政體、多民族、多宗教聚集區域，這種多元文化特徵對沿綫順暢的人文交流帶來了巨大挑戰。因此，發揮香港作為中西文化交匯融合和東南亞華人華僑集聚地的國際大都市優勢，為“一帶一路”的人文交流提供重要示範作用，加快自身人文交流平臺的建設，推動香港國際旅游城市的發展。

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3、 毛艷華，香港經濟轉型的三大難題探析[J]，學術研究，2007年第4期。
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作者簡介

毛艷華，中山大學粵港澳發展研究院教授、自貿區綜合研究院副院長；榮健欣，中山大學港澳珠江三角洲研究中心博士後。

附錄

表1　按經濟活動劃分的本地生產總值百分比分布

挑選經濟活動		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
製造		4.8	4.2	3.7	3.2	3.1	2.9	2.7	2.0	1.9	1.8	1.8	1.6	1.5	1.4	1.3
建造		4.9	4.5	4.1	3.7	3.2	2.8	2.7	2.5	3.0	3.2	3.3	3.4	3.6	4.0	4.3
服務		87.3	88.1	88.9	89.8	90.5	91.3	91.8	92.9	92.6	92.7	93.0	93.1	93.0	92.9	92.8
	進出口貿易	18.3	18.8	19.6	20.6	21.4	22.5	21.3	20.2	20.8	19.6	19.7	21.1	20.4	19.7	N.A.
	批發及零售業	3.3	3.4	3.2	3.0	3.6	3.6	3.6	3.4	3.8	3.8	4.1	4.8	5.0	5.3	N.A.
	住宿及膳食服務	2.9	2.7	2.5	2.2	2.7	2.7	2.9	3.0	3.3	3.1	3.2	3.5	3.6	3.6	3.6
	運輸及倉庫	7.2	7.0	7.4	7.4	8.0	8.0	7.5	7.1	5.8	5.9	7.6	6.0	5.7	5.7	N.A.
	郵政及速遞服務	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	N.A.
	信息及通訊	3.3	3.5	3.7	3.7	3.3	3.3	3.3	3.2	3.0	3.0	3.2	3.3	3.5	3.6	3.5
	金融及保險	12.8	12.1	12.3	13.3	13.1	13.8	16.7	20.1	17.1	16.2	16.3	16.1	15.9	16.5	16.6
	地產	5.0	4.6	4.3	4.0	4.1	4.4	4.3	4.5	5.2	5.5	5.1	5.6	5.8	5.0	N.A.
	專業及商用服務	4.2	4.2	4.2	4.4	4.7	4.4	4.4	4.7	5.0	5.5	5.7	5.7	5.7	5.7	N.A.
	公共行政、社會及個人服務	19.0	20.1	20.2	20.2	19.4	18.0	17.0	16.3	17.2	18.2	17.0	16.5	16.8	17.0	17.2
	樓宇業權	10.8	11.3	11.2	10.7	9.8	10.1	10.3	9.9	11.0	11.5	10.6	10.3	10.3	10.4	10.5

注：以基本價格計算。資料來源：香港政府統計處

表2　選定主要經濟活動的勞工生產力指數變化（2000年=100）

	整體經濟	製造業	進出口貿易業	批發及零售業	運輸、倉庫、郵政及速遞服務業	運輸及倉庫業	住宿及膳食服務業	信息及通訊業	金融業	保險業
2001	99.4	96.9	101.8	102.0	101.8	102.0	89.9	105.5	93.5	110.3
2002	101.3	96.5	109.2	99.3	108.3	108.3	83.3	110.1	97.4	111.4
2003	105.7	94.9	122.7	96.8	108.4	108.0	73.6	121.8	113.9	124.7
2004	111.1	95.4	134.5	100.0	116.6	116.3	86.7	130.6	134.9	138.3
2005	117.3	98.3	150.1	106.4	124.2	123.7	93.9	135.1	146.6	127.4
2006	124.7	104.7	164.7	114.9	129.8	130.0	103.4	141.3	164.4	150.5
2007	129.4	106.2	170.9	121.4	134.4	134.6	107.4	148.4	188.4	159.7
2008	134.1	105.7	192.1	127.4	141.1	141.0	110.6	148.6	176.2	172.1
2009	133.6	106.4	182.0	128.9	138.4	138.7	102.6	158.4	180.0	175.5
2010	138.9	122.8	204.3	150.5	145.0	143.9	109.0	157.4	179.3	191.4
2011	144.4	127.9	224.4	184.8	157.0	155.9	117.9	158.1	186.3	189.5
2012	145.7	129.2	231.6	192.2	161.7	160.2	121.5	157.6	188.2	198.9
2013	148.3	134.0	237.7	209.8	167.2	165.5	126.6	159.6	202.6	203.1
2014	153.7	141.0	247.3	212.2	183.3	182.0	130.4	163.8	212.0	206.5

資料來源：香港政府統計處

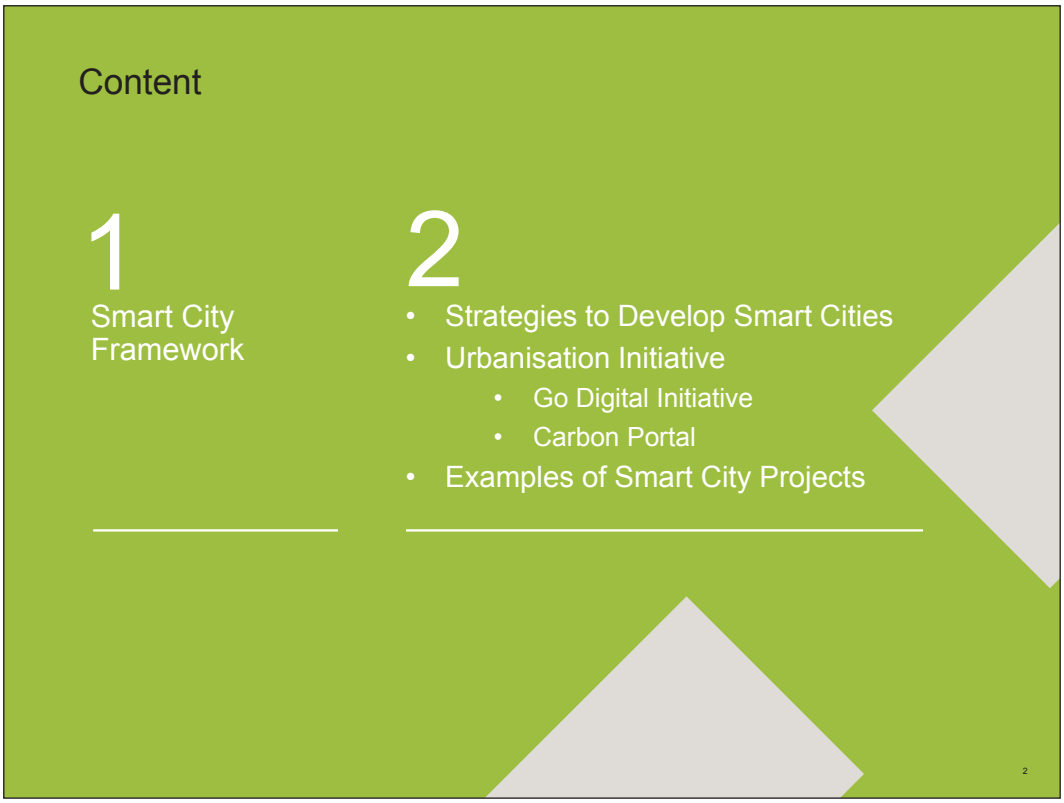
表3　香港主要貿易形態及其年變動率

	港產品出口		轉口		離岸貨品貿易	
	億港元	年變動率(%)	億港元	年變動率(%)	億港元	年變動率(%)
2002	1309.26	-14.7	14295.9	7.7	14582.52	—
2003	1216.87	-7.1	16207.49	13.4	16666.05	14.3
2004	1259.82	3.5	18931.32	16.8	18358.39	10.2
2005	1360.3	8.0	21141.43	11.7	20871.64	13.7
2006	1345.27	-1.1	23265	10.0	23464.7	12.4
2007	1091.22	-18.9	25783.92	10.8	26589.38	13.3
2008	907.57	-16.8	27333.94	6.0	33628.19	26.5
2009	577.42	-36.4	24113.47	11.8	29311.56	-12.8
2010	695.12	20.4	29615.07	22.8	38862.99	32.6
2011	656.62	-5.5	32715.92	10.5	44669.56	14.9
2012	588.3	-10.4	33755.16	3.2	46689.57	4.5
2013	543.64	-7.6	35053.22	3.8	49543.94	6.1

資料來源：香港政府統計處

發展智能城市以滿足珠三角地區的未來需求

程明錦先生
莫特麥克唐納部門董事



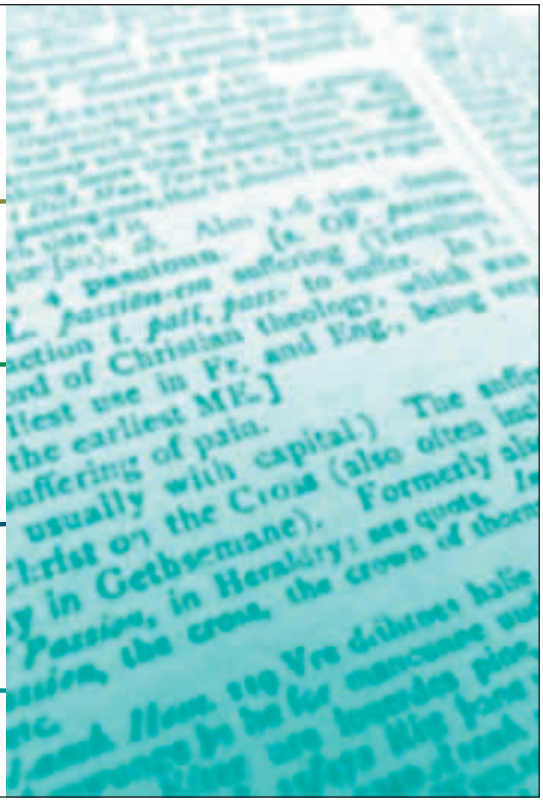
DEFINITIONS

A CITY
the people

GOVERNANCE
responsibilities

ENABLERS
transformers and technologies

DEPENDANCIES
strong connections between responsibilities



PEOPLE

Now

50% of the world population lives in cities, using

60% of the world energy, producing

CO_2 75% of the greenhouse gases

2050

2.5+Bn People will have to get access to

- Public safety
- Telecommunication
- Energy
- Built environment
- Health and human services
- Water and wastewater
- Financial aspects
- Mobility need

Source: United Nations

CITY RESPONSIBILITIES

- Financial aspects
- Water and wastewater
- Built environment
- Energy
- Health and human services
- Mobility needs
- Telecommunications
- Public safety

8 RESPONSIBILITIES

Financial aspects

- Incomes, payments, salaries, taxes are at the centre of the sustainability of a community.
- Aspects relating to payments, salaries, collection of taxes etc often not commented upon as it is the fundamental measure of success.
- Some novel ways to make cities smarter can be considered (eg the Bristol pound)

8 RESPONSIBILITIES
Water and wastewater

- Fundamental responsibilities which may be subcontracted to service providers but are nonetheless the ultimate obligation of the Authorities

8 RESPONSIBILITIES
Built environment

Public realm alongside

- Buildings
- Parks
- Recreational and leisure facilities

8 RESPONSIBILITIES
Energy

- Affordability or options
- Security of supply
- Energy mix
- Inclusion of renewables in the fuel mix
- Maintenance and upgrading of infrastructure to support the energy generation, transmission and distribution

8 RESPONSIBILITIES
Health and human services

- Health
- Education
- Social Welfare
- Grievance mechanisms

8 RESPONSIBILITIES
Mobility needs

Increasing public expectation of
- Reliability
- Convenience
- Affordability
- Options
- Quality

8 RESPONSIBILITIES
Telecommunications

Planning for multi-modal point-to-point telecommunication systems that provide
- Large bandwidth
- Future proofing
- Resilience
- Data security

8 RESPONSIBILITIES

Public safety

- Justice, law and order
- Emergency and disaster management services (includes Fire, Ambulance Services and Paramedics)
- Climate Resilience and Response Plans

7 TECHNOLOGY ENABLERS

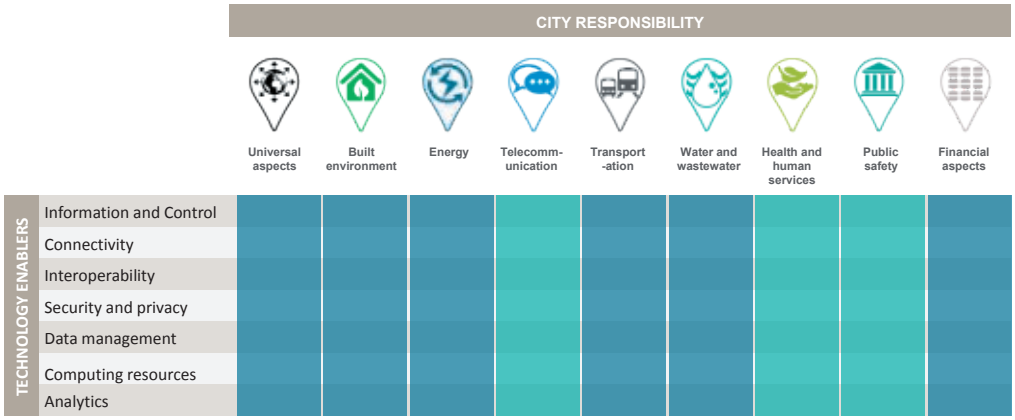
- Instrumentation and control
- Connectivity
- Interoperability
- Security and privacy
- Data management
- Computing resources
- Analytics

DEPENDENCIES

- Connection between smart city responsibilities
- City systems, services and infrastructures are connected
- Understanding dependencies is another reason to bring cross-departmental teams together early in your smart city planning process

16

READINESS OF A CITY TO BE "SMART"



Source: Smart City Council

17

Strategies to Develop Smart Cities

- Urbanisation Initiative
  - Go Digital Initiative
  - Carbon Portal
- Examples of Smart Projects
  - Jaipur, India - Smart city concept plan
  - Masdar City, Carbon Neutral City
  - Sino-Singapore Tianjin Eco-city

19

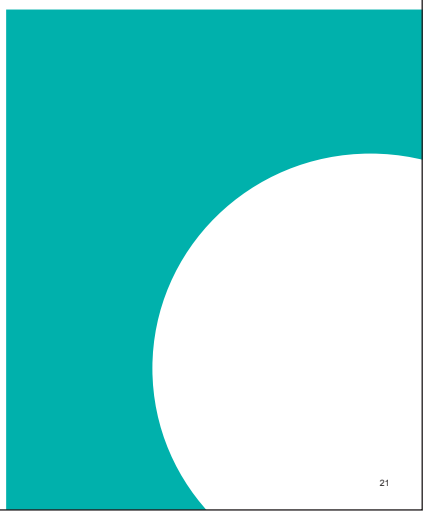
Mott MacDonald Urbanisation Initiative

A multidisciplinary Group-wide taskforce bringing together global know-how and nurturing innovation to meet the needs of a growing population.

Urbanisation Initiative

Tackling new challenges, creating new opportunities

- Harnessing our expertise to deliver workable, efficient, resilient and affordable solutions
- Aligning skills to assist in developing new city expansion projects
- Providing customers with an integrated total urban development service



21

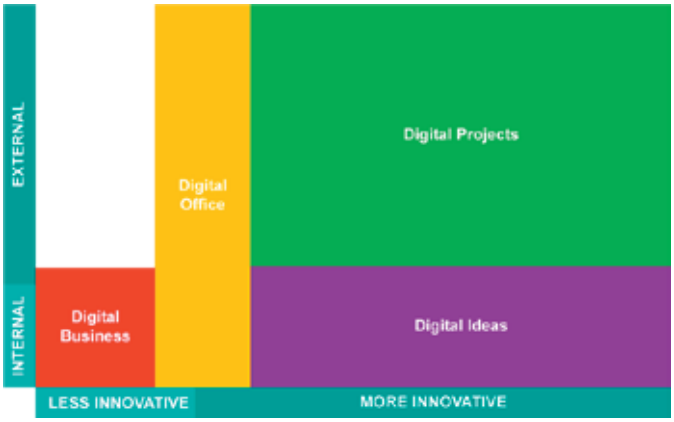
Mott MacDonald Go Digital Initiative

Innovating through technology and data to shape better insights, solutions and outcomes; simplifying and connecting what we do, delivering excellence to our clients today and opening opportunities for tomorrow.

22

GoDigital framework

Digital Business
Digital Office
Digital Ideas
Digital Projects



23

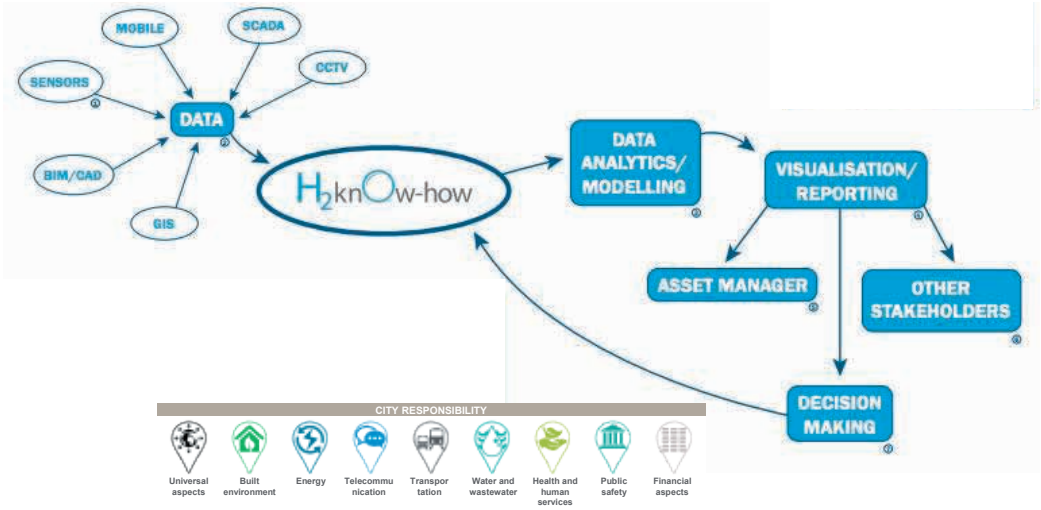
Smart Toolkit

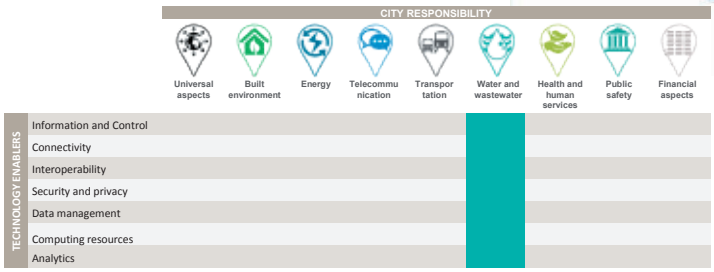
Our in-house tools combine ingenious thinking with powerful digital capability to develop big data project solutions for smart cities that are more effective, more sustainable and provide better value for money

24

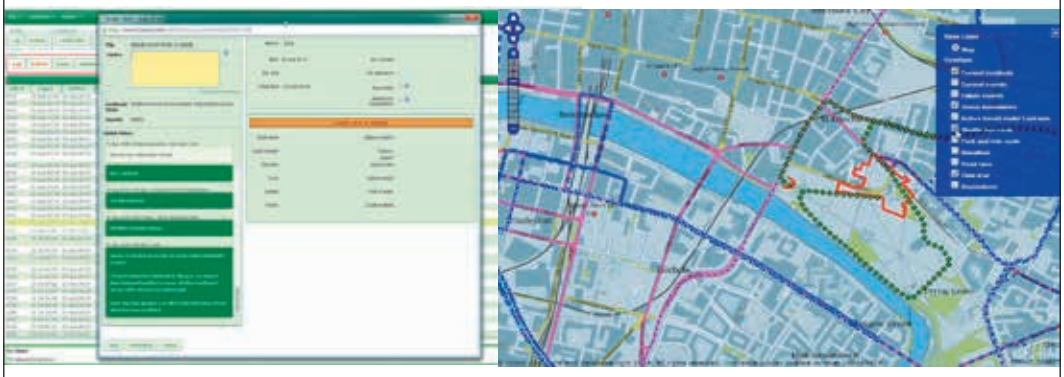
H2kn0w-how - Cloud based water management system

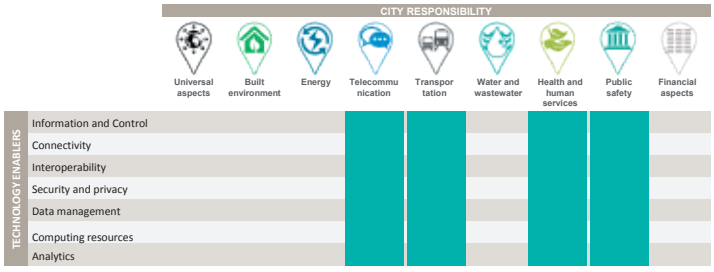
How H2kn0w-how works?





Merlin - Technology support for tactical and strategic command

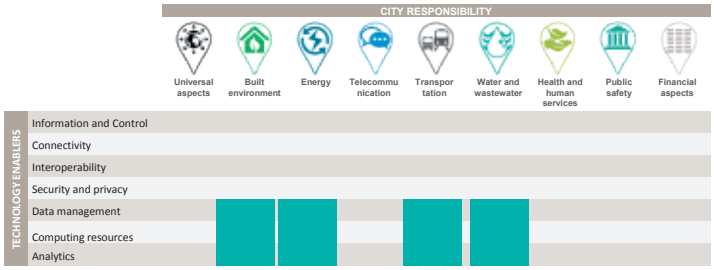




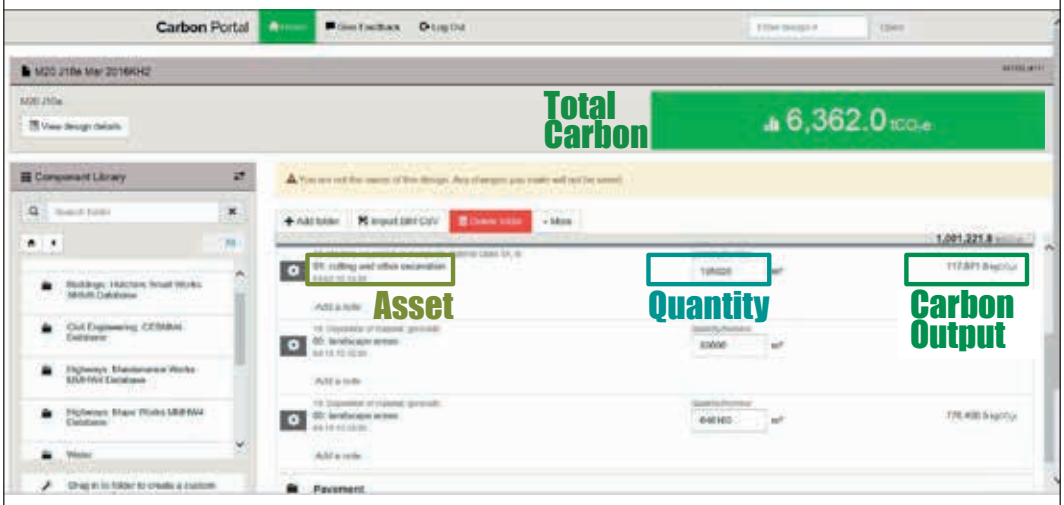
Mott MacDonald's in-house Carbon Optioneering Tool

- Draws on a comprehensive carbon data set for urban developments
- Provides Carbon Emission Value

Developing Specific HK emissions discussing with industry and research partners

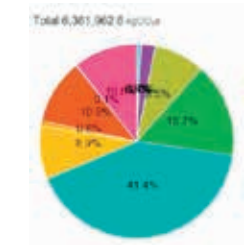


Portal calculates carbon

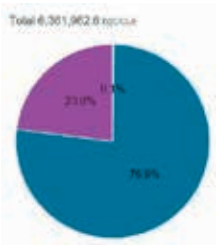


Analyse results

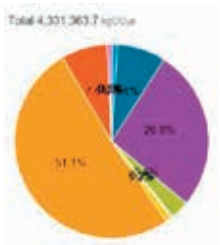
All folders in design



By scope



By material



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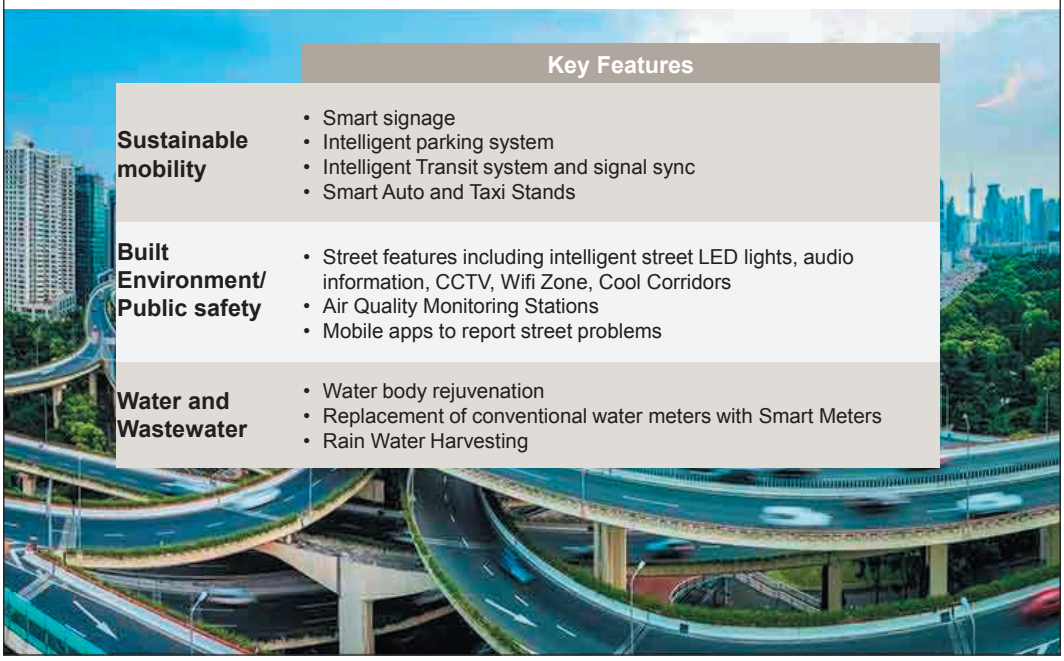
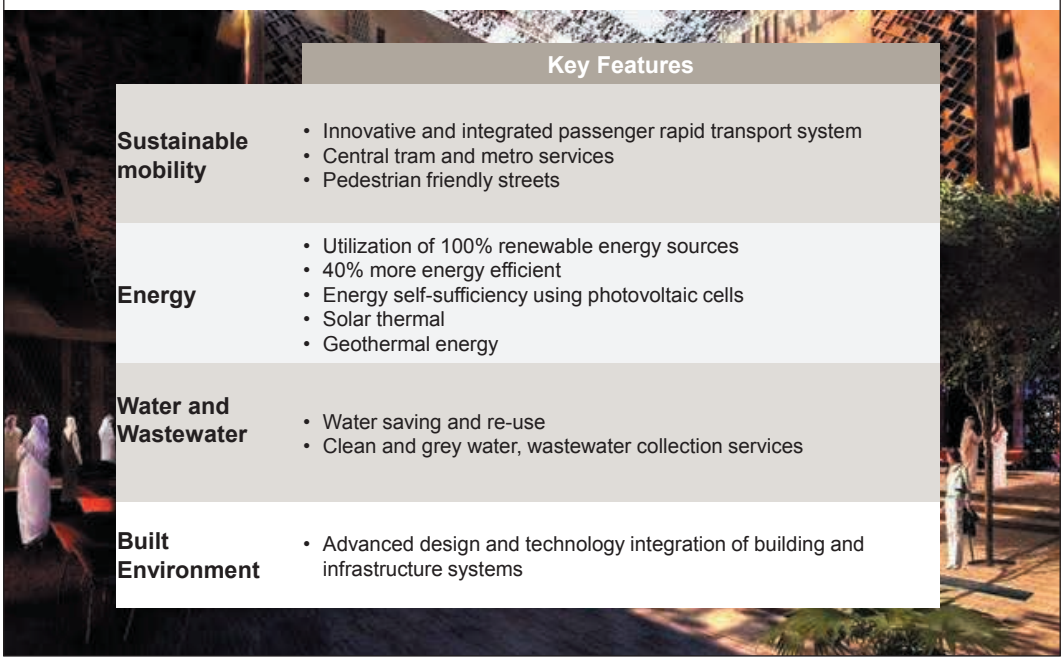
Examples of Smart City Projects

Jaipur, India - Smart city concept plan



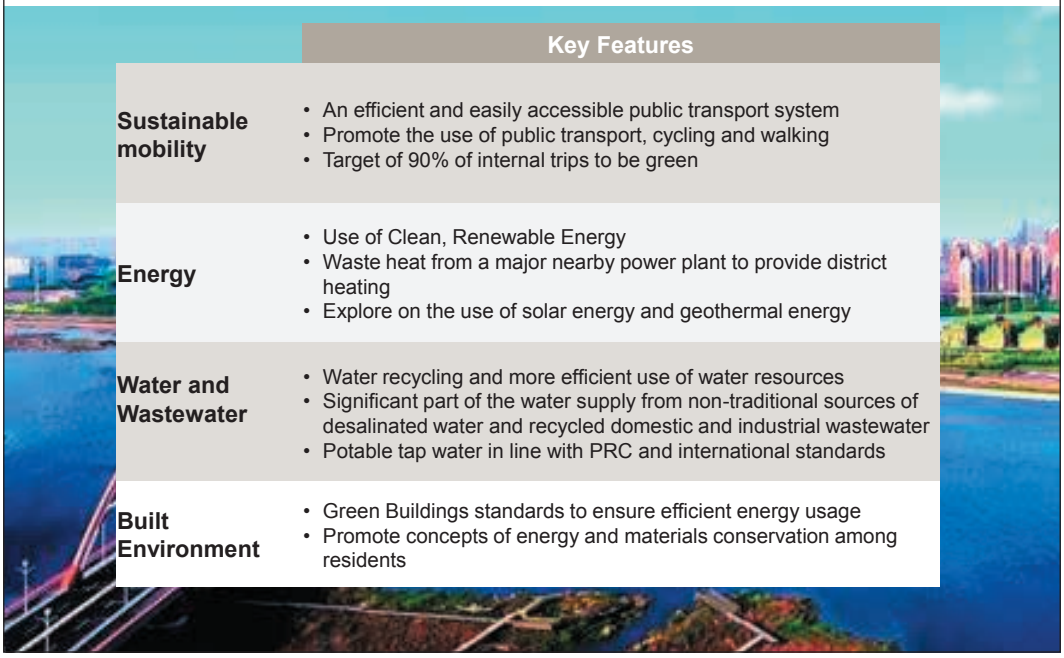
	Key Features
Sustainable mobility	• Smart signage • Intelligent parking system • Intelligent Transit system and signal sync • Smart Auto and Taxi Stands
Built Environment/ Public safety	• Street features including intelligent street LED lights, audio information, CCTV, Wifi Zone, Cool Corridors • Air Quality Monitoring Stations • Mobile apps to report street problems
Water and Wastewater	• Water body rejuvenation • Replacement of conventional water meters with Smart Meters • Rain Water Harvesting

MASDAR CITY, UAE- Carbon Neutral City



	Key Features
Sustainable mobility	• Innovative and integrated passenger rapid transport system • Central tram and metro services • Pedestrian friendly streets
Energy	• Utilization of 100% renewable energy sources • 40% more energy efficient • Energy self-sufficiency using photovoltaic cells • Solar thermal • Geothermal energy
Water and Wastewater	• Water saving and re-use • Clean and grey water, wastewater collection services
Built Environment	• Advanced design and technology integration of building and infrastructure systems

Sino-Singapore Tianjin Eco-city



	Key Features
Sustainable mobility	• An efficient and easily accessible public transport system • Promote the use of public transport, cycling and walking • Target of 90% of internal trips to be green
Energy	• Use of Clean, Renewable Energy • Waste heat from a major nearby power plant to provide district heating • Explore on the use of solar energy and geothermal energy
Water and Wastewater	• Water recycling and more efficient use of water resources • Significant part of the water supply from non-traditional sources of desalinated water and recycled domestic and industrial wastewater • Potable tap water in line with PRC and international standards
Built Environment	• Green Buildings standards to ensure efficient energy usage • Promote concepts of energy and materials conservation among residents

MOTT MACDONALD

Thank You!

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「一帶一路」發展下香港國際機場面對的機遇和挑戰

馮永業先生
香港機場管理局企業發展執行總監

摘要

在「一帶一路」戰略的帶動下，中國與相關沿線國家和地區互動頻繁，將加快沿線國家和地區的經貿往來。據統計，近年，中國「一帶一路」沿線省份新建機場15個、擴建機場28個，「一帶一路」民航建設項目共有51個項目，總投資多達300億美元。沿線地區經濟規模將達到21萬億美元，各國迫切需要航空物流方面的整合和發展，巨大市場空間將促進國際航線的發展，預計未來10年，人流和貨物流動規模也將空前增長。

「一帶一路」的重點在於加強地區聯繫、以及建設海、陸、空三路的高效網絡，為沿線地區的跨境投資、基建發展與貿易融通創造機會。香港以其國際專才與人脈、風險管理與企業管治經驗聞名，成為區內資訊、資金、貨物與人才的樞紐。在不斷轉變且充滿挑戰的經濟、生態、科技及社會環境下，香港國際機場致力提升營運能力，持續發展。

香港國際機場是全球第三大國際客運機場，也是全球最繁忙的貨運機場。作為南中國面對世界的門戶，為了維持整體競爭力和配合「一帶一路」的戰略發展，香港國際機場未來發展將朝著以下幾個大方向：

首先，香港國際機場將積極擴建成為三跑道系統，應付區內長遠的航空運輸需求。今年的8月1日，香港國際機場的三跑道系統工程正式啟動，整項建造工程將歷時八年，預計於2024年完成。工程將須填海拓地約650公頃，並會分階段完成，以便進行其後的上蓋工程，例如興建新跑道、滑行道系統及設有57個停機位的三跑道客運大樓。為保護環境，三跑道系統項目將使用深層水泥拌合法等免挖方法拓地，以儘量減少填海對海洋生態造成的影響。三跑道系統建築物在設計、施工及營運方面，會採納多項環保及可持續發展措施。興建三跑道系統不只是興建一條新跑道，而是牽涉多項工程，規模幾近在現有機場旁邊興建一個新機場。

三跑道系統建造需時，其間航空運輸需求不斷增長。單是今年上半年，香港國際機場的客運量及飛機起降量比去年同期分別上升5.1%及2.6%，達3 520萬人次及204 750架次。有見及此，香港國際機場的中場客運大樓在今年3月31日正式啟用，為機場持續發展奠下另一重要的里程碑，在三跑道系統完成之前應付機場持續增長的中期航空交通需求。

此外，香港國際機場連繫香港與珠江三角洲，是重要的多式聯運樞紐。於2015/16年度，在機場乘坐航天跨境轎車及內地客車經陸路出入境的跨境旅客達210萬人次，航天跨境轎車每天開出約560班，而從內地開出到機場的客車則每天約有550班。海天客運碼頭提供往來香港國際機場與珠三角及澳門口岸的快船服務，年內碼頭的客運量上升至281萬人次。未來幾年港珠澳大橋和廣深港高速鐵路等主要跨境及本地基建項目相繼落成，會進一步加強香港國際機場和珠江三角洲的聯繫，為此香港國際機場也在跨境設施方面不斷推陳出新，提高旅客服務體驗。

近年全球航空業發展迅速，以中東為例，其機場以吸引中轉旅客的市場策略，成就高速的客運量增長。香港國際機場要作為一個國際航空樞紐的持續發展，中轉旅客的重要性不容忽視。中轉旅客是航空公司的重要客源。在競爭日趨激烈的今天，誰能將不同航線上的城市連接起來，誰就能成功佔領航空運輸市場。對於樞紐機場而言，航站區內的旅客中轉流程設計尤為重要。為此，香港國際機場高度重視及不斷優化中轉旅客的流程設計。

為貫徹可持續發展的原則，香港國際機場環保計劃就主要環境範疇制訂了一系列減少環境影響的措施，包括氣候變化／減碳、節約能源、環保採購及零售、空氣質素、廢物管理、廢水處理及回用、生態及生物多樣性、噪音及環境管理系統。同時，香港國際機場也是本地社區的重要資源。機場的未來發展可成為推動本地企業實驗技術創新方案之地，以及為本地藝術工作者提供展示香港藝術文化的平臺。機場需與社區共同成長，為社會創造就業。為此，機場正籌畫投資社區的策略和平臺，以帶動機場島上所有營商夥伴，投資社區，貢獻社會。

我們深信香港國際機場未來的發展，能配合「一帶一路」戰略的實施，共創新機遇。

香港可持續發展的獨特優勢及國際經驗

陳永康工程師
香港綠色建築議會執行董事

1. 香港推動可持續發展的獨特背景

香港位處中國東南方珠三角地區，總面積約為1,100平方公里，當中約六成土地是山坡，缺乏易於發展的平地[1]。香港面向南中國海，擁有長約456公里的天然海岸線，包括世界知名的天然海港維多利亞港，多樣性的地理環境使香港擁有豐富的生物資源[2]。憑藉獨特的中西歷史文化背景及經濟貿易活動，香港由開埠初期只有七千多人的漁港[3]，急速發展成為一個人口超過700萬人的國際大都會。為應對人口急劇增長，香港政府於1973年展開一系列新市鎮發展計劃以舒緩市區人口擠迫的問題[4]，以及多個基建項目以配合經濟發展，包括水塘、海底隧道及地下鐵路系統等。然而，經濟急速發展為香港帶來大量污染問題，屏風式高樓大廈亦阻礙了城市空氣流通，引致熱島效應，積聚空氣污染物，為社會及環境帶來負面影響。有見及此，香港多年來制訂不同環保法例如《環境影響評估條例》等規管發展工程[5]，推動研究及應用不同的環保建設技術，加上多年與外國專業人士交流和 融合中西技術，使香港在可持續綠色建築發展於地區上領先。

2. 香港於可持續發展領域的優勢及經驗

2.1 可持續城市規劃及監察制度

香港於1939年制訂《城市規劃條例》，為大部分土地用途擬訂法定圖則以作法例規管。香港雖擁有超過七百萬人口，卻只有6.9％用地被規劃成住宅，保留了73.2％土地為自然環境及農業用途[6]，防止因城市擴展而過度開發鄉郊土地。為應對人口急增，香港自1976年起規劃鐵路發展，以能源效益較高的鐵路交通作基礎，建立「鐵路及物業綜合發展模式」[7]，於鐵路沿線作城市規劃及高密度發展，使香港75％的人口及84％的工作均集中於交通點一公里範圍內，交通便利亦使香港成為世界上其中一個低汽車擁有率的地區。公共交通導向發展規劃使香港於經濟增長的同時和能源消耗脫鉤[8]，減低人均碳排放及汽油使用量，證明鐵路發展模式能減少對環境的負面影響。而香港政府於1998年實施《環境影響評估條例》，亦規定指定項目需進行法定的環評程序，實行緩解措施，方可獲得環境許可證以開展項目。

2.2 專業綠色建築評估知識及人才

香港自1996年起推行「香港建築環境評估法」，是世界上第二套實行的環保建築評估標準。及後香港綠色建築議會於2010年推出「綠建環評」認證，更於2011年獲政策支持，發展項目如獲得「綠建環評」認證，將滿足環保及完善生活設施獲批總樓面面積寬免的其中一項先決條件。經評估的項目最高可獲寬免總樓面面積一成，為建築師預留足夠空間於樓宇加入環保元素，成為推動業界打造環保建築的一個重要誘因[9]。此外，香港因應自身特殊的密集城市弱風環境創立及應用獨特的「空氣流通評估」[10]，以及於發展項目加入「微氣候研究」，透過收集數據減低發展對城市空氣流通的影響，亦可改良項目建築群及公共空間設計以獲得更佳節能效果，盡量減少能源消耗。

香港綠色建築議會於2010年推出「綠建專才」認證課程，為香港業界提供具環保建築知識及經驗的認可專業人士，將最新的環保技術及標準融入工程當中，至今已有逾3,000位專業人士考獲「綠建專才」認可資格[11]，於香港或亞太地區發展項目提供環保方面的專業意見。

3. 香港可持續發展項目範例及國際項目參與經驗

3.1 基礎建設發展項目

鐵路發展是建設可持續、高效及低碳排放社區的關鍵。「鐵路加物業綜合發展模式」為香港多年來提供環保而有效率的交通網絡並帶動地區發展，2011年深圳物業項目「天頌」更是香港企業首次於境外實踐相關模式，為國內建立創新而可持續的土地綜合利用發展，減少交通擠塞及空氣污染問題[12]。而香港於東南亞及歐美等地亦有不同的鐵路發展及合作項目，技術及經驗得到國際間廣泛認同[13]。

基建發展同時亦應顧及對本地自然環境的影響。因著環評條例的要求及社會不同持分者的意見，2007年落成的香港上水至落馬洲鐵路支線為避免破壞高生態價值的塱原濕地，選擇以造價較高昂的地底隧道方式穿越地區，是平衡社會發展和環境保育的可持續發展模楷。

橋樑及機場建設對連接區域經濟發展是不可或缺的。2009年開始興建的港珠澳大橋，其橋、島、隧道一體的設計使其成為世界上最長的跨海大橋，亦是世界首條深埋式深水沉管隧道。項目採用了世界首創的深插式鋼圓筒快速成島技術及不浚挖式填海方法等環保措施，減少對海域的污染[14]。於2016年啟用的香港國際機場中場客運廊亦運用了「建築信息模擬(Building Information Modelling)」，透過準確預計物料量從而減少產生建築廢料[15]。

香港工程公司亦為上海虹橋商業區核心區南、北變電站建造熱電冷聯產配電系統[16]。這個系統是內地同類型最大的環保供電系統之一，以天然氣作發電燃料，並運用當中產生的餘熱作熱能供熱，同時使用吸收式製冷機組提供冷氣，大大提高能源效益，有助減少碳排放。

3.2 環保建築項目

香港多年來不斷應用嶄新環保建築技術，啟發業界向可持續方向發展。於2012年落成的「零碳天地」是香港首座零碳建築，運用光伏板及由廢食油製成的生物燃油產生能源，使建築可自給自足之餘，更有剩餘電力輸出到公共電網以抵銷建造過程及建築材料本身所使用的能源[17]，比一般國際間對零碳建築的定義更進一步。而杜拜政府於2008年亦與香港企業合作興建「生態綜合體球(Technosphere)」，利用太陽能、風力技術發電以達致零碳排放，及採用污水處理循環系統淨化污水作種植或沖廁用途，自給自足[18]，成為世界環保建築的模範。

除了新建建築外，為現有建築翻新及加入環保元素亦是社會邁向可持續發展的重要一環。位於香港灣仔的華潤大廈總部翻新工程設計中運用了大量環保建築技術，包括裝設低放射性雙層玻璃幕牆改善採光照明，拆卸和重置部份樓層以改善自然通風等[19]，改善舊有建築及社區的環保表現。

3.3 公共事業項目

可持續城市發展提倡使用潔淨或可再生能源。香港早於1994年與內地合作營運廣東大亞灣核電站，這是內地首座大型商業核電站，為香港輸出潔淨電力，其安全性及效率於全球核電發展中具領先地位，並贏得多個國際獎項[20]。香港企業亦有於內地設廠研究開發焦爐氣及農耕廢料轉化天然氣以產生能源[21]、以及於印度參與的太陽能發電項目[22]，向外輸出可再生能源技術及經驗。而於雲南西村的光伏電站工程更揉合了「農光互補」元素[23]，除了善用土地資源外，亦為農村帶來經濟機遇及潔淨能源。至於污水處理方面，香港亦從外國引入「污水再造」技術，利用薄膜滲濾技術將污水變成可用水作非飲用用途[24]。

4. 香港與大灣區的可持續發展配合及機遇

可持續發展是未來大勢所趨，在「一帶一路」計劃中同樣著重綠色經濟發展，與其他國家合作推動綠色低碳建設，提高跨境經濟合作區發展。為配合「一帶一路」，粵港澳大灣區將擁有世界上最大的港口區、機場群和城市群，而香港於相關方面的綠色技術已有相當優勢及國際經驗。

在航運方面，香港貨櫃碼頭及國際機場均可維持高用量的同時透過不同節能及審計措施減低碳排放，獲得國際環保獎項[25, 26]。香港建立的「鐵路及物業綜合發展模式」，適合人口密度高的城市發展，與未來大灣區的城市及地區發展可產生協同效應，加上香港金融服務及法規可協助廣東營商環境更加國際化，促進綠色經濟發展。而香港多年來已發展成為一個國際城市，與東南亞及歐美等地合作發展環保項目，有效促進地區與國際間的商貿往來。香港企業長久以來於環保上亦累積了不少經驗及專業人才，擁有國外最新環保技術，在國內亦有價格

低廉零件供應網絡，使其可於各地綠色發展項目擔當不同角色。

香港於可持續發展方面累積的獨特優勢及國際經驗將有助「一帶一路」下的城市發展，為廣東省地區包括香港創造潛在的環保機遇，透過跨地域合作，實現可持續的綠色經濟發展，共建綠色城市。

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綠化節能一體化現澆輕質混凝土墻體施工工藝研究

李建新　陳培鑫　費飛龍　陳耿

一、前言

進入新世紀以來，我國各級政府將墻體材料革新列為建築節能的重要內容之一。對于建築物的墻體來説，除了要求其具有一定的力學性能之外，還要求其具有優良的保溫、隔熱、隔聲、防水、防火等性能。而對于墻體而言，若采用砌築方式，人力成本高，施工效率低，隨著勞動力成本的逐年攀升與機械化施工的推進，現場砌築已不適應當前建築發展的需求；若采用預製墻板，其機械化施工的優點無法在室內裝配中得到體現，切割容易產生建築垃圾，在管井、拐角、梁下等部位容易產生死角。

輕質混凝土用于現澆墻體是重大的技術突破，在根本上解決了建築保溫、隔聲、輕質、環保、安全以及工業化生產的問題，是建築節能的重要方向。近年來，國內許多泡沫混凝土企業已開始發展現澆自保溫外墻、承重或非承重隔聲內墻等，而且已形成了開發熱潮，一大批應用技術正在各地緊張研發中。國內有研究者采用現澆泡沫混凝土自保溫複合墻體，采用優質輕鋼龍骨作為框架，用纖維水泥壓力板為覆面，在龍骨與纖維水泥壓力板所形成的墻體空腔中，澆注泡沫混凝土，硬化後形成夾芯型輕質複合墻體，是一種可以現場澆注的新型保溫複合墻體。然而泡沫混凝土由于自身質輕低强，不能作為承重墻體，而且泡沫混凝土與模板的結合力不强，這些都制約著其進一步發展。

本技術以混凝土結構的梁、柱作為支撐點，采用鋁模作為模板，中間植入鋼筋網片和構造柱，構造柱與墻體植筋連接，預埋綫盒、管綫和預留孔洞、門窗，門窗洞口設置過梁；采用混凝土攪拌站預拌砂漿，現場利用自動化發泡裝置製備出容重可調可控的輕質混凝土，並通過泵送設備將具有流動度好、易泵送、高强抗裂的輕質混凝土澆注在模板當中，質量穩定、施工便捷，實現墻體節能、防火隔音、平整度好、免抹灰、管綫預埋、吊挂强等多功能一體化，兼顧了墻體的整體性和功能性，實現了現澆輕質墻體的機械化生產施工和水電土建一體化生產。該技術系統具有施工速度快、表面平整度好、綠色環保、綜合成本低等優點，符合當建築業轉型升級的發展方向。

二、現澆輕質混凝土墻體技術特點

現澆輕質混凝土墻體卓越的功能越來越被建築行業所接受，與傳統的現澆墻體相比，其操作簡單，主要有以下特點：

（1）輕質高强。輕質混凝土密度一般在600~1400㎏/m³範圍內，根據設計等要求，可在施工現場通過調整砂漿、發泡劑用量，可調整其密度，作建築物的墻體使用，可大大減輕建築物的自重，從而降低建築物的結構與基礎費用，經濟效益顯著。在減輕重量的同時還具備足够的强度，其中，密度800㎏/m³泡沫混凝土抗壓强度近8MPa，密度1200㎏/m³泡沫混凝土抗壓强度超過14MPa。

（2）熱工性能優良。與傳統的建築材料相比，輕質混凝土熱導率較低，密度等級600~1400 ㎏/m³之間的泡沫混凝土，導熱係數在 0.08~0.30W/m • K 之間，保溫隔熱效果顯著。

（3）良好的防火隔音性能。輕質混凝土是多孔型材料，因此它是一種具有一定吸音能力的材料，吸音性能比磚墻大約高5-10 倍。輕質混凝土是非燃性能的，它的熱傳導性能低，熱遷移慢，從而能保護其他構件不受火灾的影響，在高溫下也不產生有害氣體，120mm 厚輕質混凝土墻體的耐火極限不低于3h，因而具有良好的防火性能。經檢測，燃燒性能符合A1級。

（4）墻體外觀質量較好，管綫預埋、免開洞開槽。墻體外觀質量較好，平整度高，表面平整度允許偏差小于±3mm，無需抹灰，可直接做裝飾面層，可大大節省人工費用，節約成本，提高效率。該技術通過預

埋綫盒、管綫和預留孔洞、門窗，一體化施工，免開洞開槽。

(5) 安全、環保、無毒、無污染。該體系所用的材料幾乎全是無機材料，安全健康、環保無毒。

(6) 機械化施工，施工便捷。采用混凝土攪拌站預拌砂漿，現場利用自動化發泡裝置製備出容重可調可控的輕質混凝土，並通過泵送設備將具有流動度好、易泵送、高强抗裂的輕質混凝土澆注在模板當中，質量穩定、施工便捷，泵送澆注的速度可與澆注商品混凝土的速度媲美。

三、現澆輕質混凝土墻體施工工藝

輕質混凝土現澆墻體是由放綫、植筋、支模、預埋管綫、澆注輕質混凝土和輕質混凝土凝固後拆模等部分工序組成。輕質混凝土現澆墻體施工工藝如圖1所示。

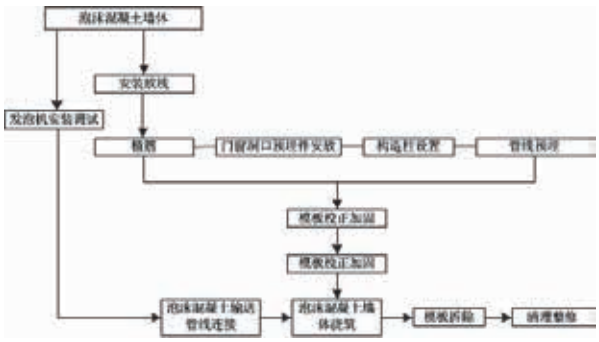

圖1 輕質混凝土現澆墻體施工工藝圖

3.1 輕質混凝土墻體放綫支模

框架柱與輕質混凝土墻體連接處，錨固拉結筋必須按設計要求布置。模板安裝前，要做好模板的定位基準工作，工作步驟為：按圖紙要求有輕質混凝土墻體的地面清掃乾淨，進行中心綫位置的放綫：首先引測建築的主軸綫，並以此軸綫為起點，彈出每條軸綫。模板放綫時，根據施工圖彈出模板的內外邊綫和中心綫，以便于安裝和校正模板。做好標高測量工作，用水準儀把建築物水平標高根據實際標高的要求，直接引測到模板安裝位置。模板安裝時注意鋁合金模板的安裝按照先內墻、後外墻的順序安裝,安裝完畢後應進行垂直及水平標高的調整，如圖2。安裝內墻模板先從填充墻部位開始單側支模，在單側模板安裝就位、初步支撐加固後，安裝結構間緩衝隔離帶以及水電管路布管，如圖3。模板安裝見輕質混凝土墻體模板安裝示意圖如圖4所示。

圖2 鋁模板安裝圖

圖3管綫安裝圖

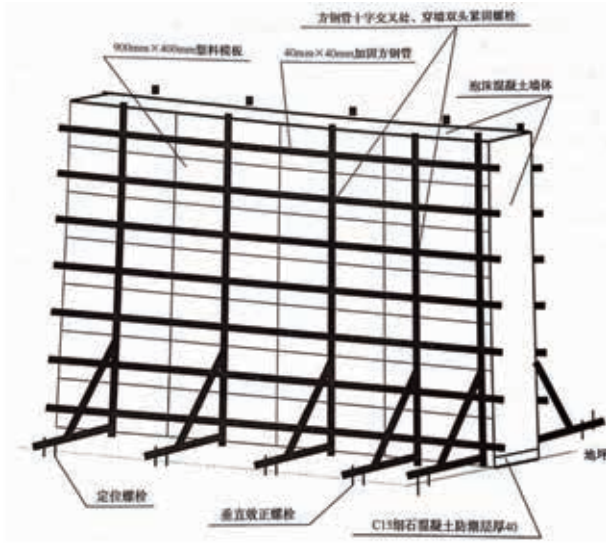

圖4輕質混凝土墻體模板安裝示意圖

在對應墻板澆築口的頂板模板上預留方形澆築口，此澆築口在輕質抗裂混凝土澆築完畢後，用定制模板封蓋，如圖

圖3鬥型澆築口

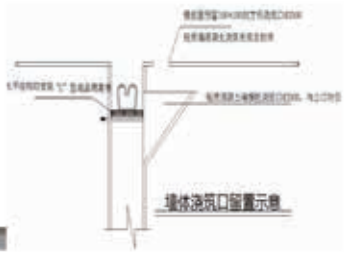

圖4 澆築口留置圖

墻體截面支撐用料應采用專用支撐。拼接嚴密不得有漏漿現象，模板平整度、垂直度應符合規範要求，方鋼管扣件、雙頭螺栓加固緊密不應有鬆動現象，必要時采用48×3.0鋼管與扣件混合加固。模板安裝校正加固完成，檢查拉結筋、門窗洞口預埋件位置是否正確，水、電、管綫及預留位置是否正確，清理乾淨模板內的遺留物品，檢查報驗合格後準備澆注。

3.2 填充墻內門過梁和構造柱配筋

（1）過梁：洞口寬度小于1.2m時，在洞口頂部設置兩根φ12（三級鋼筋）的鋼筋，鋼筋伸入洞口兩側不小于400mm；當洞口大于1.2m時，在洞口頂部設置三根φ12（三級鋼筋）的鋼筋，鋼筋伸入洞口兩側不小于400mm；以上過梁端部靠結構體時，均按配筋伸入結構體長度≥400mm。

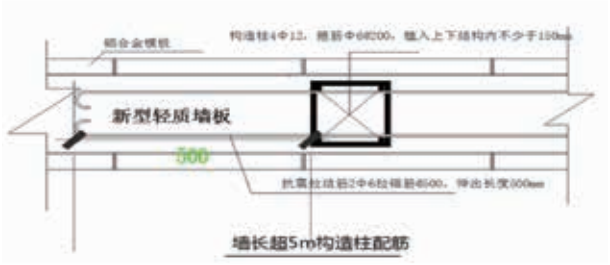

圖5 構造柱配筋留置圖

（2）單墻墻長大于5m的按照圖紙設計要求中間加設構造柱，在結構體內按構造柱配筋植筋，頂部伸入結構體長度≥200mm，底部植入結構體內長度≥150mm，如圖5。

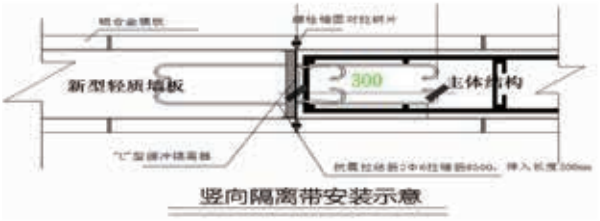

圖6 竪向隔離帶放置拉結筋圖

（3）竪向結構緩衝隔離器上預留孔洞，放置2φ6拉結筋，間距500mm，伸出長度300mm（≥錨固長度43d），如圖6。

3.3 輕質混凝土製作和澆築

泵送混凝土前，先把儲料斗內清水從管道泵出，達到濕潤和清潔管道的目的，然後向料斗內加入與混凝土配合比相同的水泥砂漿，潤滑管道後即可開始泵送混凝土。嚴格按設計的技術指標和配合比要求施工，嚴格控制每立方米輕質混凝土中水泥、發泡劑、砂、細石、陶粒、各種外加劑或輕質混凝土專用乾粉料的用量。

本技術采用混凝土攪拌站的濕拌砂漿，有利于配合比穩定性。施工現場使用專用輕質混凝土製備設備，製備出容重可調可控的輕質混凝土，並通過泵送設備將具有流動度好、易泵送、高强抗裂的輕質混凝土澆注在模板當中，澆築輕質混凝土應連續進行，間隔時間不應超過2小時，當墻體高于4米時應分層澆築，因輕質混凝土塌落度高、自流性强，故無需內部振搗。

3.4 拆除模板及清理整修

輕質混凝土澆注後1天可以拆模，輕質混凝土凝固後應及時拆模，進行輕質混凝土質量驗收並及時清理整修。澆注孔及梁板下墻體表面平

整密實，多餘的輕質混凝土漿料應鏟平。墻體兩端及頂端與主體結構交接處的縫隙應采用嵌縫膏等柔性材料填充。墻體的接縫處應將雜物清理乾淨，出現孔隙時采用聚合物水泥砂漿填實。拆模後對輕質混凝土墻面進行整修處理後開始自然養護，輕質混凝土養護時間不少于7d，一般拆模2ld後做面層裝飾。

3.5 工程質量驗收

拆模後，技術人員要進行初步驗收。光潔度要好，無麻面，無空洞，無裂縫；用尺實測，平整、垂直度控制在2~3mm以內；澆注時要留好試塊，以保證檢測28d的幹密度和强度(標養一組，同條件)。現場取100mmx100mmx100mm樣品做幹密度和抗壓强度等相關性能檢測。

四、實施示範工程

目前已完成多項示範工程，施工5萬m2，墻體質量穩定、施工便捷，達到了墻體節能、防火隔音、平整度好、免抹灰、管綫預埋、吊挂强等多功能一體化。圖7為廣東建工集團綜合樓墻體工程實施效果圖，表1、表2為現澆輕質混凝土墻體檢測結果。

圖7 廣東建工集團墻體工程

表1 現澆輕質混凝土墻體材料(800 kg/m³)檢測結果

序號	檢驗項目	標準技術要求			檢驗結果
1	外觀與尺寸偏差	表面平整度允許偏差，mm		±10	+3
		裂紋長度，mm/m²	平面	≤400	105
			立面	≤350	90
		裂紋寬，mm		≤1	0
		厚度允許偏差，%		±5	+1
		油污、層裂、表面疏鬆		不允許	無
2	幹密度，kg/ m³	≤800			791
3	抗壓强度，MPa	平均值：≥7.50			7.80
		最小值：≥6.375			7.21
4	吸水率，%	≤5			3
5	導熱係數，W/m • K	≤0.21			0.18
6	燃燒性能	–			A1

表2 現澆輕質混凝土墻體材料(1200kg/ m³)檢測結果

序號	檢驗項目	標準技術要求			檢驗結果
1	外觀與尺寸偏差	表面平整度允許偏差，mm		±10	+3
		裂紋長度，mm/m2	平面	≤400	85
			立面	≤350	90
		裂紋寬，mm		≤1	0
		厚度允許偏差，%		±5	+1
		油污、層裂、表面疏鬆		不允許	無
2	幹密度，kg/ m³	≤1200			1187
3	抗壓强度，MPa	平均值：≥15.00			16.1
		最小值：≥12.76			15.5
4	吸水率，%	≤5			2
5	導熱係數，W/m • K	–			0.26
6	燃燒性能	–			A1

五、展望

該技術現澆輕質混凝土墻體，用于房屋內外隔墻工程，具有施工速度快、表面平整度好、免抹灰，一次性預埋管綫、綫盒、預留孔洞、門窗洞口，吊挂力强、整體性好，具有防火、隔聲、自保溫隔熱等優异性能。相比于傳統砌築施工工藝速度快，實現機械化施工；拆模後墻體平整度達±3mm，無需批蕩，減少建築垃圾；施工時將管綫、綫盒提前預埋；墻體吊挂力强、可直接埋入螺栓；材料輕質可減輕建築物自重，同時降低整體造價。該輕質高强泡沫混凝土現澆墻體技術，成功解决了泡沫混凝土垂直澆築側向壓力過大而導致坍模，因沉降分層不均勻的問題，垂直高度3~4米的墻體可實現一次性澆築，整個施工過程較砌磚工期縮短近一半，有效降低工程管理成本，提高投資收益率，使企業取得了良好的經濟效益和社會效益。

現澆輕質混凝土墻體技術符合建築產業化政策發展的方向，將商品混凝土公司、模板企業、水電安裝、土建及裝修企業等有機結合，有效促進綠色施工推廣及落實建築節能，為企業帶來良好的經濟效益和社會效益，從節能、環保、綠色及提高建築工程質量等多個方面都具有十分重要經濟和社會意義。

可持續發展變電站：環保及應對氣候變化的電力供應
Sustainable Substation: Green and Climate Resiliency for Sustainable and Reliable Supply to Hong Kong

撰稿人　陳國華先生
中華電力有限公司工程項目總監
輔助撰稿人　何兆光先生
中華電力有限公司資產管理總監

1. INTRODUCTION

The Hong Kong Special Administrative Region (HKSAR) is one of the most densely populated regions in the world. Highly reliable, efficient and environmental friendly power supply is essential to the development of this modern and dynamic city. CLP Power Hong Kong Limited (CLP Power) operates a vertically integrated power supply business, covering electricity generation, transmission and distribution, and marketing and customer services, and providing a safe and reliable electricity supply to about 80% of the population in HKSAR. In order to meet the flourishing needs of this city, the company is committed to providing and maintaining a secure and reliable supply through adoption of new technologies, systematic and innovative approaches in the development of Smart Grid for the transmission and distribution of electrical power supply. One of the key features of the CLP Power's Smart Grid is the sustainable substation where environmental friendly design of the substation building and green construction practices are employed. The case for adapting the substation to climate change is also compelling. Features have been provided in our substations that enable resilience to climate change.

Figure 1: Recent Sustainable Substation Developments

This article describes the experience in the development of the sustainable and smart substations, with the optimum design guided by the CLP Power's Sustainability Development Framework.

2. DESIGN

Systematic Approach — Environmental Design Guideline

'Care for people', 'Care for the community' and 'Care for the environment' are core values of the company. These core values guide the mission in the efficient use of resources, manage key environmental impacts responsibly and monitor the environmental performance for continuous improvement. The mission is translated into the practical tools that are applied in the daily operations such as `Environmental Design Guideline'.

Table 1: Key Objectives of Environmental Design Guideline:

- A performance framework to promote environmental considerations
- stimulate environmental innovations in design and construction processes
- raise expectations on environmental performance among various participants
- enhance the corporate image

Sustainability is an important consideration in designing the new substation. CLP Power commits to the responsible employment of resources and environmental stewardship.

Figure 2: Four Design Guidelines Directions of Environmental Design Guideline

The *Environmental Design Guideline* (EDG) is tailor made for the design and maintenance of substations. This guideline which consolidated most of the state-of-art design techniques provides a streamlined and user-friendly guide to the process of planning and design of substations and other structures, identifying key issues of each stage for substation project and serving as a reference for the administrative and managerial duties of the company. The EDG aims to help each participant better understand their roles in the design of improved and more efficient substation buildings with minimal environmental impact, through full compliance with all applicable environmental regulations and permitted limits, corresponding to the corporate goal (Table 1).

According to the special functions of the substation, four Design Guideline directions are adopted in EDG; namely `site selection', `substation layout', `architectural, structural and building services' and `other considerations'.

With the commitment of CLP Power to the responsible employment in resources, enhancing productivity is one of the main considerations in the environmental design of the substations. Similar to the suggested environmentally friendly practices mentioned in BEAM Plus for New Building published by Hong Kong Green Building Council, six modules of Environmental Design in sustainable substation development, including `site aspects', `material aspects', `energy and water', `indoor environmental quality, `innovations' and `enhance productivity' are outlined in EDG. Through the crossing of four design directions and the six modules of environmental design, a number of environmental design provisions have been developed for the substation developments. The followings are some examples:

Figure 3: Directions and Modules of Environmental Design Guideline

Site Aspects

- substations will be located away from the existing sensitive buildings
- context design approach is adopted for blending in with the environment

Material Aspects

- durable external wall tile
- reusable metal formwork
- low-e glass
- reduces waste by means of reduction, reuse and recycle

Energy & Water

- natural ventilation approach is applied to dissipate heat generated from the transformer if possible
- energy efficient lighting such as light-emitting diode (LED)
- reduce artificial lights

Indoor Environment Quality

- oil interceptor for all oil type transformers
- flue pipe from the diesel fire pump is directed away from the public

Innovations

- Adoption of BIM
- display of heritage items that are excavated from the site
- vertical banner in front of the transformer bay that can also enhance the natural ventilation process

Enhancing Productivity

- simple structure and spatial flexibility for future expansion work
- dual fan ventilation system for the battery and charger room

This Guideline also provides a thorough review of the environmental issues arising from the substation development including the operation phase. Through proper planning and design, the potential environmental impacts can be minimised not only to satisfy requirements of the relevant environmental legislations but also to attain the corporate goal on the environmental protection.

Increasingly, green initiatives are making their way into the mainstream practice through corporate leadership, leading to high performance of the sustainable substation. The Guideline sets out targets for substation building environmental standards, means to achieve those targets, and necessary tools and references. It also provides examples of practical and cost-effective substation design. These examples encourage best practices while striving to overcome many of the conventional approach to substation building design. This Guideline is reviewed regularly among CLP's management staff, designers, contractors, operators, external authorities and the public in order to address the changing concerns and expectations.

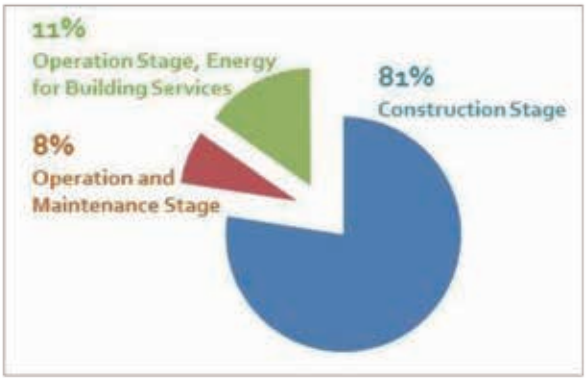

Figure 4: LCA Model facilitates Development of Sustainable Substation Building

Life Cycle Analysis and Energy Utilisation

CLP Power is the first power utility company in Hong Kong to adopt Life Cycle Analysis (LCA) in the substation design in order to measure the cradle-to-grave operating and maintenance costs, and merits in terms of global and local environmental issues for all building members.

Figure 4 indicates the environmental impacts during various major phases of the life cycle of a substation development – construction, operation and demolition. According to the LCA model, the building materials / installation constitute the major environmental impact

(about 81%) during the total life cycle of the substation. Since the substation is unmanned, together with an energy efficient design, the combined life cycle impacts for 'maintenance' and 'energy consumption' phases of a typical substation is about 19% only.

Figure 5: Lighting Design addresses Safe Operational Requirement inside Switchgear Room

CLP Power has joined the Hong Kong Energy Efficiency Scheme for Buildings for the substation buildings since 2003. Although mandatory Building Energy Code does not apply to the substation building, all the building services installations in the newly developed substations of CLP Power are complied with the Codes of Practice for Energy Efficiency. The illumination level inside the substation is designed according to standards and meets the safety operational requirements (Figure 5). Lighting installation of different illumination levels (100 – 400 lux) are provided for different areas inside the substation. Large areas are divided into different lighting control zones where individual lighting switches are provided to control lights in each zone. Only rooms with special electronic equipment are required to maintain the air temperature and humidity. Dehumidifiers are provided in addition to the air-conditioning system because the dehumidifier consumes less energy than that of the air-conditioning unit.

Compact Substation Design

The compact building design reduces the amount of construction work and the associated carbon footprint of the substation building. The size of the substation can be reduced without sacrifice of space for operation and maintenance of the plant equipment. The following strategies have been implemented to reduce the size of the substation (higher site coverage %):

Figure 6: Increase in % of Site Coverage for Substations in the last 10 years

- no Emergency Vehicular Access inside the substation
- effective cable route layout
- Ring Main Unit (RMU) deck above access route

One example is the 'stack up' of the electrical plant above the passage area. In a traditional substation, the heavy plant equipment is located on ground floor with adequate space for access and transportation of the plant equipment. With this `stack up of electrical plant space', the size of the substation and the associated civil work are reduced.

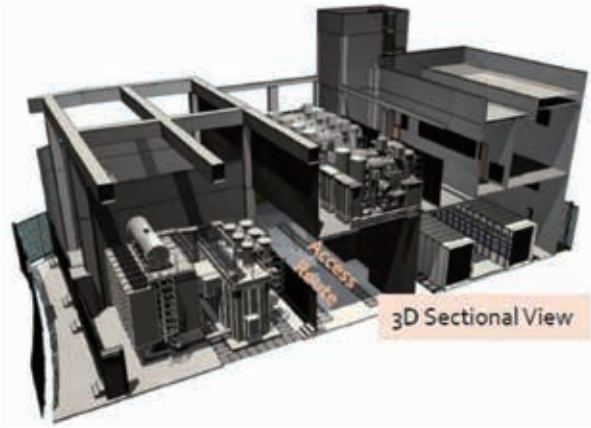

Figure 7: Stack up of Plant Equipment Space inside the Substation

Other Design Considerations

There are other challenges in the design of the substation such as small land lot, difficulties associated with the wayleave and entry of high voltage cables, opposition from neighbours, high priority of projects and short schedule for substation energisation. Early stakeholder engagement, value engineering study, planning for supply reliability and security issues have to be taken into consideration.

Usually the substation building is a low-rise structure design in order to blend-in with the environment (Figure 8). Native vegetation are planted on the ground level, roof and external walls with 'drip-pipe' irrigation system. Humid sensor with logic circuit is installed to control the operation of the irrigation system.

Figure 8: Substation Blends-in with Environment

Various features will be provided to mitigate the environmental impacts to neighbours. Lights will be provided in the open yard area of the substation for security reason. Lighting pollution will be avoided by providing outdoor lights at a lower level and with cut-off angles. Low-noise type transformers will be installed. Green 'telfon' screens will be provided in front of the transformer bays in order to mitigate the visual impact to the public. All paintings, sealants and adhesives will be of low-VOC types. Non-CFC based refrigerant will be employed in the air-conditioning system.

3. CONSTRUCTION

Green Procurement

CLP Power adopts "Green Purchasing" and is one of the founding members of the Hong Kong Green Purchasing Charter, pledging to take environmental impacts into account during the procurement process. With a risk-based approach, the company considers 'environmental impact' during all stages of the project, including product design, selection of raw materials, manufacturing method, packaging and distribution, through to the end of the product life.

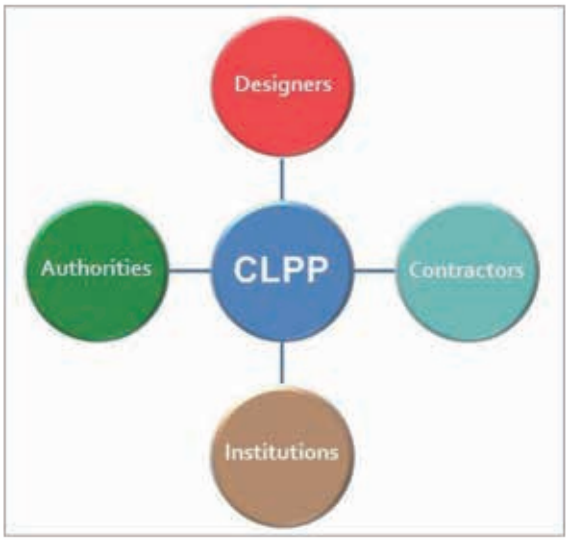

Figure 9: Participation Model allows Synergistic Teamwork

Participation Model and 5S House Keeping System

Under the Participation Model (Figure 9), the company takes the lead to organise a special task group with members from different disciplines of the construction industry. This task group is formed to explore new opportunities and develop innovations to enhance the safety and environmental performance of the site work. With the synergy effect, more safety and environmental initiatives are developed in a continuous manner. Construction companies with adequate competency and environmental awareness are recruited as strategic business partners of the company. Sharing sessions of knowledge among the strategic partners are conducted frequently.

The '5S housekeeping' system is implemented during the construction of the substation. A committee consisting of key personnel from the main contractor and subcontractors is established to implement the housekeeping system. Regular meetings and audits are conducted. Through daily morning briefing, good housekeeping practices are conveyed to the frontline workers. Weekly inspections with subcontractors are conducted to monitor their housekeeping performance. During the work, the performance of the contractor is monitored systematically. Feedback to the contractor regarding their performance is conducted periodically.

In order to further enhance the safety and environmental performance, the 'Construction Management Plan' is implemented at the construction site of the substation. Staffs from the senior management level to the frontline workers from the project management team, designers, consultants, main contractor and subcontractors are involved in the implementation of this 'Plan'. Prior to the commencement of the site work, all major safety and environmental risks have been identified and risk mitigation measures have been developed. The site work risk mitigation measures are presented in pictures, simple word descriptions, cartoons and animations that can be easily understood by the frontline workers. These pictures and descriptions are displayed at prominent positions of the site. Communication sessions about the 'Plan' and work improvement measures with animations are conducted for the site workers regularly.

Zero Waste Plan

CLP Power aims to move towards the goal of 'zero waste' in the construction site by exploring opportunities in reducing the surplus materials, as well as reusing and recycling waste materials on site. The following standard procedure for waste reduction at construction site has been established:

- identify key construction wastes to be managed
- develop action plan and programme by means of avoiding, minimising, reusing, recycling and finally waste disposal with the desirability decreasing in this order
- monitor implementation of the action plan
- audit the result and identify the opportunity for continuous improvement

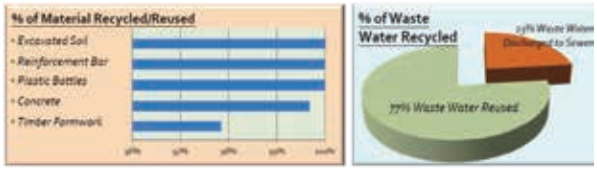

Figure 10: Result of Zero Waste Plan Implementation in a Recent Substation Project

Prior to delivery of concrete from the mixing plant, wastage reduction is achieved by careful planning of the ordering batches and close

monitoring throughout concreting so as to avoid ordering surplus amount, especially for the last batch of ordering.

The surplus amount of concrete and grouting is reused for making pre-cast concrete blocks and ground paving blocks (Figure 10). The pre-cast concrete blocks are used to protect cables during CLP Power's cable trenching works in the public area. Ground paving blocks are used to cover bare ground of access routes and works areas on site. Steel members and concrete masses for excavation and lateral support (ELS) work and hoarding installation are reused in other construction sites. The surplus volume of excavated soil is used as backfilling materials for cable trenches.

Steel re-bars are collected and forwarded to other environmental services company for recycling purpose. Construction water is collected and recycled for dust suppression on site. Wooden materials from the formwork are chopped into chips. Wood chips are collected and donated to the government or other organisations for mulching. A grinding machine on site serves to handle the plastic wastes such as the plastic bottles for recycling.

Sorting facilities are provided in the building site to separate and accommodate inert construction materials including bricks and concrete, scraps of metals, and excavated soils. Pieces of brick and concrete fragments can be used for ground paving, and metal scraps have their scavenge value.

4. INNOVATIONS

The followings are some examples of innovations that have been implemented.

Building Information Modelling

Building information modelling (BIM) is adopted during new substation developments. Digital 3D model for the substation building, electrical plant facilities and major cables yields benefit ranging from harmonious design, through construction and equipment installation, to facility management of the substation.

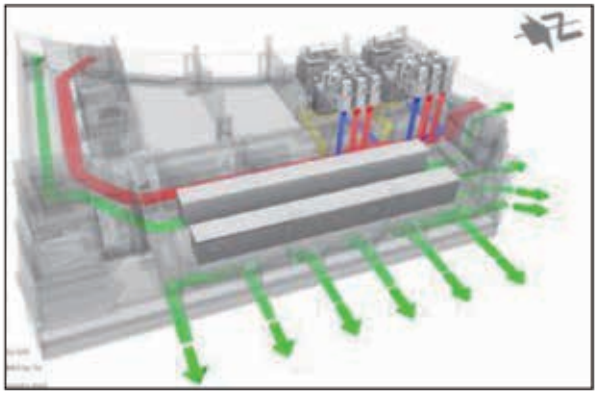

Figure 11: BIM Image of a Substation including Dispatch of Underground Cables from Substation to Customers

Design quality and the optimisation process of the substation are enhanced with the BIM process. The model helps reduce clashes, enabling mitigation of changes to works during the design stage which minimises abortive work during the construction stage.

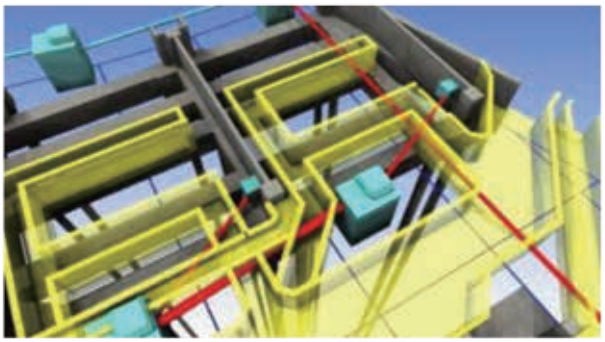

Figure 12: BIM Image of the Underground Installations at a Substation

With BIM, the complicated underground installations of the substation such as cable trenches, structure provisions, drainage pipes and manholes pipes are shown on the 3D model (Figures 11 and 12), which can easily be understood by people of different disciplines such as the builder, drain pipe worker, cable engineer, etc. Any conflict among installations can be identified and resolved prior to the site construction work.

Computational Fluid Dynamics and Enhanced Natural Ventilation

Computational fluid dynamics (CDF) (Figure 13) modelling technique is deployed during the design stage in order to optimise the building configuration for adequate natural ventilation process such as minimisation of the transformer bay. Natural ventilation for heavy plant equipment can avoid the requirement of large fan and the associated noise abatement work. Adequate natural ventilation to remove excessive heat from the plant equipment space can provide a better working environment for our operational staff and extend the life span of the plant equipment.

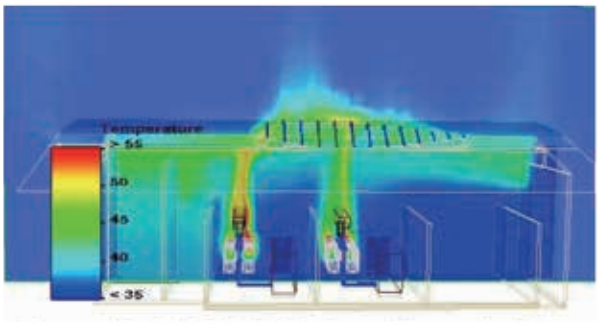

Figure 13: CFD Model Reduces Economical Cost and Environmental Cost of Substation

5. FEATURES FOR CLIMATE RESILIENCE

CLP Power has introduced additional measures – apart from those incorporated during the design stage - to sharpen its emergency preparedness in light of the rapid changing climate condition. Among all important tasks, one of the focuses has been put in safeguarding the power equipment, which are installed inside the substations, against storm surges and rising sea water level. Further to a comprehensive risk assessment process, a series of upgrades for prevention, mitigation and damage control measures have been implemented to protect flood-prone transmission (132kV or above) and distribution (11kV) substations in the face of growing threats posed by climate change.

Figure 14: Typhon Usagi in 2014

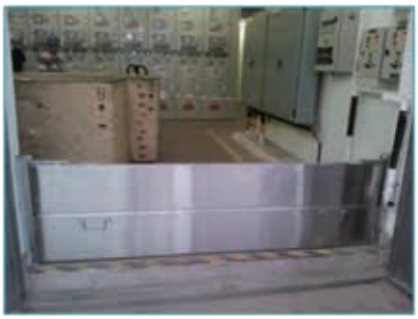

Figure 15: Installation of Flood Gate

Figure 16: 2-stage Flooding Alarm

To counteract the potential impact of a storm surge on Hong Kong's power supply, CLP Power has upgraded mitigation measures which include installing flood gates, sealing the cable inlets, equipping the substations with sump pumps and 2-stage flooding alarms at 11 flood-prone transmission substations and approximately 500 distribution substations in accordance with their level of flood risk.

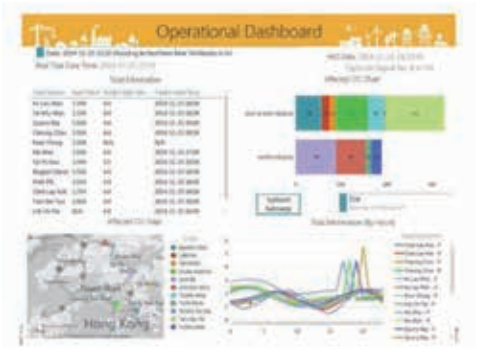

Figure 17: Flood Calculator

CLP Power has also developed a computerised flood alert tool (flood calculator), which evaluates the flood risk at substations during typhoons based on forecast storm surge and sea level data, and real time sea level data provided by the Hong Kong Observatory. Its functions are to serve:

a) for planning purpose to assess the worst case scenario of flood risk to substations resulting from storm surge brought by typhoons and

b) for operation purpose to identify substations at flood risk due to anticipated storm surge during typhoon attack and issue 24 hours ahead flooding pre-warning for these substations through alert emails and SMS.

The flood calculator allows for meticulous monitoring and timely coordination of the CLP Power System Control Centre to avoid any damage to power supply equipment.

Contingency plan for load transfer and shut down of those high risk flood prone transmission substations is ready for emergency preparedness.

6. CONCLUSION

As a leading and responsible power company, CLPP has continuously pursuing the goal of intelligent and sustainable developments to fulfil the social commitment. Innovations are developed continuously over the traditional practices and customs. Features for the resilience of climate change are provided in the substation developments. The company takes a proactive approach to adapt to the rapid changing environment of the 21st century.

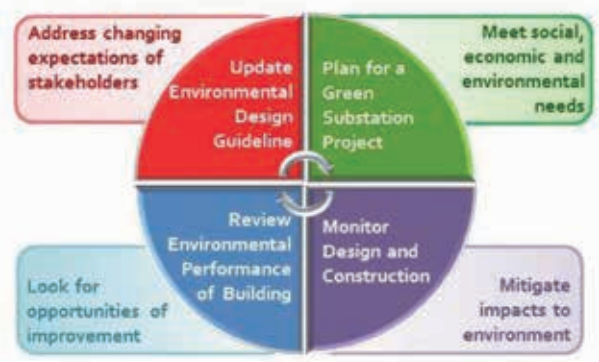

Figure 18: Green Development Approach

Working along with our partnering contractors, there has been a consistent trend observed from the construction projects that our contractors were carrying out pollution control with better systematic approach. A noticeable saving of materials and energy were achieved through innovative design and construction methods. CLP Power as the property owner regarded the importance of sustainable design, construction and operation in our infrastructure development projects.

Community development issues are becoming more important. It has been an increasing challenge for CLP Power to communicate with members of local community who perceive the site for the power transmission plant facilities to be hazardous to them, and do not want the corresponding development being adjacent to their homes even though they understand the need for an evolving supply network. It becomes longer, more expensive, bureaucratic and difficult for building substations.

It is necessary to address concerns of the local community/residents in the long-term planning of the substation development. Building trust with the public and a positive corporate image through a sustainable approach to the project development is critical for the company in resolving challenges and gaining public acceptance.

CLP adopted a 'green' development approach (Figure 18) to gain the public acceptance of the site and reduce objections from the local community for the substation developments, aligning with the government and considering potential 'community related' issues during the planning stage. More works such as 'less depletion of natural resources' and 'green construction method' will be needed in developing applicable sustainable development programs and measures to make substations 'intelligent' and more acceptable by the community.

ACKNOWLEDGEMENT

The authors wish to thank the Management of CLP Power for the support and permission to publish this paper.

建築餘泥渣土受納場建設管理技術調研
—以深圳、香港建築餘泥渣土受納場爲例

許燕祿
總工室／廣東省建科院
廣州／中國

陳茜
設計院／廣東省建科院
廣州／中國

劉遠亮
地基二所／廣東省建科院
廣州／中國

1 序言

根據廣東省住房和城鄉建設廳《關于發布建築餘泥渣土受納場建設標準制訂計劃的通知》（粵建科函〔2016〕226號），2016年初，我院組織開展了《廣東省建築餘泥渣土受納場建設技術規範》編制的任務。建築餘泥渣土受納場建設技術規範目前在國內尚屬空白，為了更好的完成編制任務，編制組組織各參編人員到廣州、深圳、香港等地察看建築餘泥渣土受納場建設及運營情況，為標準編制學習借鑒有益的先進經驗。

調研組由省建科院許燕祿帶隊，劉遠亮、陳茜協調安排，省建設工程質量安全監督檢測總站、省城鄉規劃設計研究院、省建築設計研究院、廣州市市政工程設計研究院、深圳市城市規劃設計研究院有限公司、中冶長天國際工程有限責任公司、深圳市建築科學研究院股份有限公司、深圳市地鐵集團有限公司、深圳市建設工程質量安全監督總站等單位派代表參加了調研。

2 調研情況

2.1 深圳部九窩受納場

2.1.1部九窩受納場總占地約107公頃，設計總庫容約2690萬m^3，最高堆填高度約150~160m。該受納場僅受納深圳地鐵建設產生的餘泥，受納物品種單一、特性顯著。

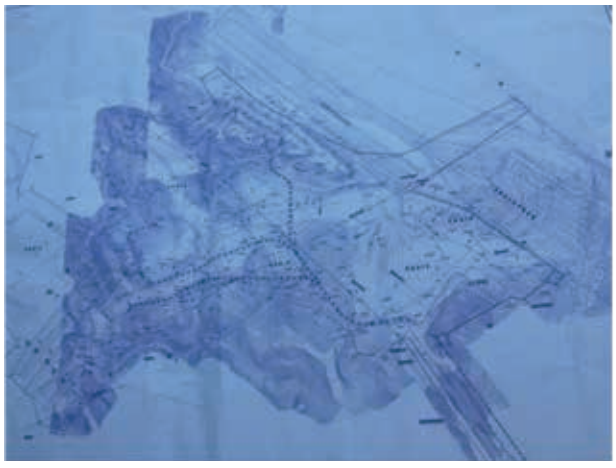

圖2.1-1 深圳部九窩受納場總平面圖

2.1.2受納場分三期建設，調研時一期工程已封場並做完了綠化，綠化主要為草和小樹苗，二三期工程正在建設之中。受納場內共有6個構造壩，其中5個在一期，1個在三期；構造壩均為土壩，壩下方墊有級配碎石，保證壩內積水的排出，碎石上層為填土。

2.1.3受納場堆填區為分層堆填，每層堆填高度為10m，放坡比例為1:3.5，每層放坡下有10m寬的平臺。平臺土的壓實度約為86%，每傾倒0.5m的泥土就用壓路機進行壓實，構造壩下土的壓實度要求不低于96%。

2.1.4受納場堆填區每豎向20m高左右設置一排水平方向的盲管，管材為PVC，管徑按照每個盲管匯水面積計算確定，大小為1.2~2m不等。排水盲管上穿孔，墊碎石加土工布，保證排水不堵塞。設集水豎井將平行布置的盲管收集到的水導入到下一層；盲管出口處設置沉砂池，經澄清後的水排入市政管網。

圖2.1-2 水平排水溝圖

圖2.1-3 自然放坡和複綠圖

2.1.5受納場一期工程堆填區的綠化，平臺區域種植樹木，放坡的坡面種草，保證雨水能快速經過坡面流走。

2.1.6受納場監控情況：設置專業監控設備進行監控，監控內容包括沉降、排水及水質情況，每個月收集一次監控數據。情況特殊時增加監測頻度，竣工封場後繼續監控兩年。

2.2深圳水徑建築垃圾受納場

2.2.1深圳水徑建築垃圾受納場原場址為采石場，利用采石後形成的場地建設受納場。受納場沿山體建設，堆填高度70~80m，受納物主要為建築垃圾，至參觀時受納場已封場並基本完成了綠化。

圖2.2-1水徑建築垃圾受納場正面

圖2.2-2水徑建築垃圾受納場側面

圖2.2-3受納場水平和縱向排水溝

圖2.2-4受納場縱向排水溝

圖2.2-5受納場沉砂池

2.2.2水徑建築垃圾受納場堆填區為分層堆填，每層堆填高度為10m，頂部每層堆填高度為5m，每層放坡下有約5m寬的水平平臺。

2.2.3每層堆填平台坡脚處均設水平排水溝，寬度和高度均約為1m；每15m寬沿放坡方向設一縱向排水溝，縱向排水溝寬約1.2m，高約1m，設有人行梯級。不同高度平臺的水平排水溝通過縱向排水溝連通，形成堆體面層排水網絡。

2.2.4該受納場的受納物為建築垃圾，因此僅在受納場的最下層設盲管，堆填體中間不再設置盲管。

2.2.5堆填體最高處平臺，沿山體設排水溝，寬約0.3~0.5m，並設置沉砂池，由沉砂池過濾後接入有人行梯級的縱向排水溝。

2.3 香港將軍澳第137區填料庫

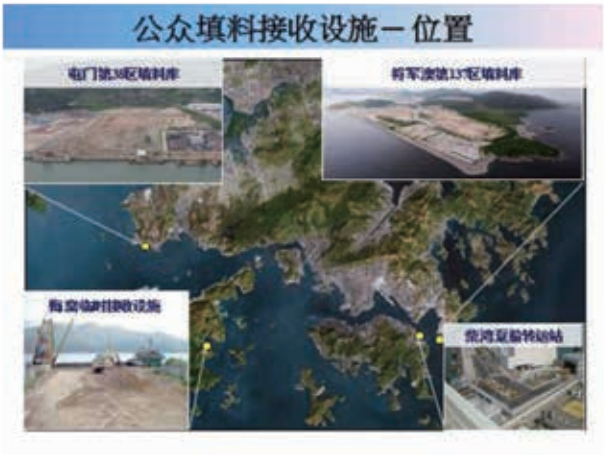

圖2.3-1香港4個公眾填料接收設施位置

2.3.1香港規劃有四個填料庫，分別是將軍澳第137區填料庫、屯門第38區填料庫、柴灣公眾填土躉船轉運站、梅窩臨時公眾填料接收設施。其規劃布局考慮有利于減少建築垃圾的跨區處理。填料庫的布點規劃由規劃、環保、地震、土木工程等部門及公眾共同參與。香港設置“公眾填料委員會—PFC”，該委員會負責提前統籌建築廢物的數據；調配建築工地產生的質量較好的建築泥土用于填海、回填地基等其他用途等職責。

2.3.2香港將軍澳第137區填料庫占地面積約104公頃，2003~2004年建成使用。該填料庫主要為建築垃圾的中轉，將堆放在該填料庫的建築垃圾裝船運往廣東地區進行填海。填料庫需取得環境許可證，填料庫與海邊距離100m，與居民區距離400m。

圖2.3-2香港將軍澳第137區填料庫作業現場

2.3.3香港將建築垃圾分為惰性垃圾及非惰性垃圾，惰性垃圾由土木工程拓展署管理，進入填料庫；非惰性垃圾由環境保護署管理，進入堆填區。建築垃圾運輸車輛必須申請傾卸泥土執照。

圖2.3-3填料庫入口登記檢驗處一

2.3.4堆填區劃分為幹泥區、濕泥區、瀝青區和夾石機四個區域，在填料庫入口處由管理人員區分（有攝像頭監控）車輛應傾卸的區域，並給司機相應傾卸區域憑證，司機按照領取的憑證去相應區域傾卸建築垃圾；夾石機區域指的是建築垃圾主要塊徑達到一定標準的石塊，該區域石塊可以重複利用，用于水渠等構築物基底填充石材。

圖2.3-4填料庫入口登記檢驗處二

圖2.3-5填料庫入口登記檢驗處三

2.3.5入庫建築垃圾的檢驗，主要由電腦隨機選擇抽查車輛：

1） 樣本抽查：每100輛車抽查1次，車前、中、後三個部分中選擇一個抽查部位，部分抽查650公斤建築垃圾。

2） 全面檢查：每1000輛車抽查2次，對車內全部建築垃圾進行檢查。

3） 被多次抽查到違規的車輛進行記錄，增加該車輛所屬建築工地的建築垃圾的抽查比例。

圖2.3-6填料庫入庫樣本抽查一

2.3.6填料庫對入庫的建築垃圾未有含水率的要求，只要可以裝車、運輸的濕泥都可以入庫。對含水率較高的泥土主要是通過自然晾曬減少含水率，也有脱水機械，但成本較高，參觀當日並未開啓該機械。

圖2.3-7填料庫入庫樣本抽查二

2.3.7整個填料庫分為三個臺地，每個臺地高8m，建築垃圾的堆置與清挖分區同時進行，高臺地堆放，低臺地挖運。

2.3.8在堆填區用小型挖掘機進行碾壓，泥頭車沿堆卸平臺的臺地邊緣傾卸後，挖掘機緊跟著一邊往臺地的坡下推，一邊對地面鬆軟的泥土進行碾壓，保證每次傾卸後碾壓次數超過10次；泥頭車傾卸與挖掘機碾壓在不同臺地同時進行。

2.3.9該填料庫由于只是中轉性質，地面僅從坡頂向內堆放碾壓成2~3%的自然傾斜放坡排水，沒有對堆填的臺地設置排水設施，但是整個填料庫周邊設置有排水溝，保證場地內污水進入排水溝沉澱後排出。

圖2.3-8 堆填區用小型挖掘機碾壓

3 調研總結

3.1 深圳兩個受納場規劃設計較好，排水設施依據受納場堆填不同受納物，有針對性的進行設計，既保證了堆填區的穩定，又減少不必要的浪費。

3.2 深圳兩個受納場的構造壩的壩體均為土壩，其中部九窩受納場構造壩的壩體下部為石頭材質，確保了堆填平台區內部水分的排出。

3.3 受納場封場後，壩體與平臺的綠化品種選擇，主要考慮要保證壩體表面雨水快速流走，不產生滯留並滲透到堆填體內。

3.4 深圳兩個受納場堆填的分級、放坡、土體的壓實要求、排水設施的做法，堆體監測、複綠等都有值得借鑒學習的地方。

3.5 香港將軍澳填料庫與本次編制的標準中定義的受納場性質不同，該填料庫主要是中轉性質，並長期不間斷的在使用。

3.6 香港關于建築垃圾的源頭控制及運營管理等方面有豐富的經驗，堆卸平臺泥頭車與挖掘機同時作業，效率非常高，都值得規範編制組借鑒學習。

本次調研，時間緊，任務重。編制組馬不停蹄，僅用兩天的時間，參觀了兩個城市的三個地方。即使在香港下著毛毛細雨，填料場地泥濘的情況下，也阻擋不了編制組調研的步伐。通過詳細查看和瞭解深圳、香港建築餘泥渣土受納場建設運營的各個細節，編制組加深和提高了對受納場建設運營的認識，為下一步編制好《廣東省建築餘泥渣土受納場建設技術規範》，高品質完成省住房城鄉建設廳下達的任務打下了良好的基礎。

作者簡介：
許燕祿：教授級高級工程師，國家一級注冊結構師，從事綠色建設政策、技術和標準研究。
陳　茜：高級工程師，國家注冊規劃師，從事規劃設計研究。
劉遠亮：高級工程師，博士，從事岩土工程研究。

以“兩山論”為指導，探索編制自然資源資產負債表

葉有華，張原，孫芳芳，李鑫，陳龍，尹雪
深圳市環境科學研究院／深圳市自然資源資產核算與評估中心 廣東深圳，518001

人與自然和諧共處、經濟與社會和諧發展是提升民生福祉、建設美麗中國的重要保障，是開展生態文明建設，實現中華民族永續發展的根本要求。早在2006年，習近平總書記就提出了“綠水清山就是金山銀山”的科學論斷，明確了經濟發展和環境效益之間的依存關係，闡述了人與自然和諧相處、經濟與社會和諧發展的科學理念。2013年總書記又將此理念進一步歸納為“兩山論”，即“既要金山銀山，又要綠水青山，綠水青山就是金山銀山。”

根據“兩山論”的科學理念，十八屆三中全會提出了探索編制自然資源資產負債表，對領導幹部實行自然資源資產離任審計的戰略要求。黨中央、國務院分別于今年5月和7月相繼印發了《關于加快推進生態文明建設的意見》和《黨政領導幹部生態環境損害責任追究辦法（試行）》，進一步明確了通過對自然資源資產的核算與審計、對生態環境損害責任追究來實現保護資源環境的目標。

當下，正值《綠水清山就是金山銀山》發表十周年之際，回顧在“兩山論”的指導下一年多時間裏探索編制深圳市和深圳所轄的兩個區自然資源資產負債表過程，提出幾點關于自然資源資產負債表編制的思考及建議，以期為我國其它地區自然資源資產負債表編制、黨政領導幹部自然資源資產離任審計、生態環境損害責任追究、生態文明建設和環境執法提供參考。

1 厘清概念，確定自然資源資產負債表基本內涵

2013年11月12日十八屆三中全會審議通過了《中共中央關于全面深化改革若干重大問題的決定》（以下簡稱《決定》），該決定明確提出要“探索編制自然資源資產負債表，對領導幹部實行自然資源資產離任審計”，指明了我國今後自然資源資產管理的方向。

資料顯示，自該《決定》印發至今，不管是國家層面還是地方層面均高度重視，與自然資源資產管理有關的國家部委局和一些地區將探索編制自然資源資產負債表這一工作列為重點改革任務或年度重點工作予以推進，並完成了初步研究，如福建福州、廣東深圳、浙江湖州、貴州荔波、海南三亞、內蒙古鄂托克前旗、湖北黃岡、山東煙臺、江蘇連雲港、四川綿陽、雲南昆明、陝西西安等。

縱觀各類新聞報道，可以看出各地區基于自身的生態系統特點啓動了自然資源資產負債表編制。事實上，當前關于自然資源資產負債表的研究非常火爆，但研究和應用相對混亂，也缺乏系統性，主要是因為自然資源資產負債表的有關概念內涵未厘清。我們在研究深圳市、寶安區和大鵬新區自然資源資產負債表時遇到的首要問題是“什麼是自然資源資產負債表”，而當下並沒有明確的概念。儘管國家有關生態文明建設的戰略部署提出了要開展這項工作，但其概念和內涵不清楚，僅提出要對“水流、森林、山嶺、草原、荒地、灘塗等自然生態空間進行統一確權登記”。與自然資源資產負債表相關的概念較多，如生態系統服務功能、生態系統生產總值（GEP）、生態資產、環境資產、自然資源資產、自然資源、企業負債表等。不同領域的專家學者關于自然資源資產負債表的理解和把握不同，所界定的概念和內涵也就不同，甚至差異極大。在地方管理層面，由于管理者的認知水平、政績要求和長官意志，其對自然資源資產負債表的認識差異就更大，甚至明顯偏離的現象也存在。

深圳市在探索編制自然資源資產負債表過程，緊扣習總書記“綠水青山就是金山銀山”的發展理論，不僅提出了自然資源資產負債表的概念，還以自然生態空間為重點，同時將人居健康相關的環境資源並入自然資源資產負債表範疇，確定了自然資源資產負債表的基本內涵，可為全國其它地區自然資源資產負債表編制提供參考。

2 確定原則，統籌設計自然資源資產負債表樣表

自然資源資產負債表提出至今，沒有人知道它長什麼樣子。將傳統政治經濟學中認為沒有價值的要素作為當下有價值的要素納入考慮，其負債表是否與企業負債表一樣？當下能完整回答這個問題的人不多。在設計自然資源資產負債表時可能需有一個基本認識，即一方面自然資源資產負債表的編制是一個逐步完善的過程，另外一方面自然資源資產負債表有且只有在實踐中才能逐步完善。為此我們確定了自然資源資產負債表的編制原則。

(1) 目標導向

《決定》中提出“探索編制自然資源資產負債表，對領導幹部實行自然資源資產離任審計，建立生態環境損害責任終身追究制度”，為此我們可以確定探索編制自然資源資產負債表起碼有兩個應用方向，一是離任審計，二是責任追究，實際上還隱藏著一個基本應用方向那就是自然資源的日常管理。我們在設計深圳市、寶安區和大鵬新區自然資源資產負債表過程中始終以該目標為導向，將這一原則貫穿到探索研究的全過程，並將自然資源資產負債表作為黨政領導幹部自然資源資產離任審計的核心內容予以考慮。

(2) 科學合理

按照“兩山論”中“綠水青山就是金山銀山”的發展理念，自然資源資產負債表中要將自然資源轉化為價值，以價值的形式反映自然資源資產的變化發展狀況。為此，科學編制自然資源資產負債表過程既要考慮自然資源的存量和質量，也要反映自然資源資產的變化，更要體現自然資源資產的價值、負債與損益。另一方面，自然資源資產負債表的編制工作要基于科學理論基礎、依托科學的核算方法、融入科學的評估體系，確保既能够準確表徵自然資源資產的特徵，又能全面反映各類自然資源的存量、質量、價值、流向、負責與權益，確保該自然資源資產負債表的科學合理性，與國際國內現有通行的資產評估體系具有較好的互融互通性，並始終保持在實踐中的生命力。

(3) 系統全面

雖然自然資源資產負債表的編制應用是一個逐步完善的過程，但不管在哪一個階段其系統性都不可忽視。自然資源資產負債表是一套表系統，由存量表、質量表、價值表、流向表、負責與權益表組成，各類表下設子系統。自然資源資產負債表涉及多個領域、多個行業、多個部門，其編制是一項系統性工作，既包括自然資源資產的各項指標，又要考慮到自然資源資產生態服務功能的各個因子。在確定評價指標時既要充分考慮到區域資源的特點，將各項指標全面納入負債表系統，同時也應準確歸納各項指標的生態系統服務功能因子，確保無重複、無遺漏。

(4) 簡潔適用

自然資源資產負債表涉及所有的自然資源，本著循序漸進，逐步完善的基本做法，在分階段推進自然資源資產負債表編制過程，在遵守科學性、系統性基礎上，提出的自然資源資產負債表應簡潔適用，具有“可報告、可核查、可考核、可審計”等基本特點。

3 建構理論，探索自然資源資產負債表核算技術方法

目前，國內外關于生態系統服務功能、生態資產、環境資產、生態審計、環境審計和單項自然資源如水資源、礦產資源的審計研究案例較多，綜合的研究和審計較少。自然資源資產負債表名詞為我國首次提出，尚未建立有關的系統理論，要編制自然資源資產負債表，則有關自然資源資產負債表的理論亟需探索建立。要踐行“綠水青山就是金山銀山”這一發展理念，將自然資源由存量和質量轉化為價值，就要建構相應的核算體系和質量價格體系，並將其作為自然資源資產負債表理論的重要組成部分予以考慮。

4 先行先試，建立自然資源資產負債表地區模式和經驗

在我國提出探索編制自然資源資產負債表，有關概念內涵尚不明確的條件下，應鼓勵各地先行先試，提出區域自然資源資產負債表編制模式，形成發展經驗。

我們在編制深圳市自然資源資產負債表過程充分體現了頂層設計與基層創新相結合，理論與實踐相結合的思路。在探索研究深圳全市自然資源資產負債表的基礎上，形成了全市自然資源資產負債表編制理論框架，並以工業發展為代表的寶安區和以生態保護為重點的大鵬新區為試點，同步開展自然資源資產負債表研究工作。2014年9月，深圳在全國率先完成了市級、縣區級自然資源資產負債表編制工作，形成了自然資源資產負債表的"深圳模式"。2015年7月，我們在內蒙古鄂托克前旗探索編制了鄂前旗自然資源資產負債表，形成了具有典型西北特色的自然資源資產負債表"西北模式"。

區域自然資源資產負債表模式的探索研究及其經驗做法不僅為當地自然資源資產管理與審計提供了技術支撐，也將為我國生態文明建設提供借鑒。

5 正視問題，推動自然資源資產負債表創新應用與管理

前面提到自然資源資產負債表的成熟編制是一個逐步完善的過程，這就說明當前的自然資源資產負債表編制還存在不少問題，有些問題還一時難以解決，需要不斷探索。我們在編制自然資源負債表過程及與有關單位溝通交流過程均發現這些問題制約著負債表有關工作的開展。

(1) 管理部門認識上存在誤區

雖然我國不少地方較早提出要探索自然資源資產負債表，但取得實質性進展的有限，主要是因為有關管理部門認識上存在誤區，一是認為將該自然資源資產負債表納入審計將影響自身政績，導致開展這項工作的積極性不够；二是認為當前的考核和審計較多或過多，而且效果都不是很理想，將自然資源資產負債表編制的工作等同于一般性工作看待；三是認為自然資源資產負債表是環保部門一家的事情，與其它部門無關，部門間缺乏配合，有關的協調聯動機制難以形成；四是認為自然資源負債表就是將當前有關資源環境工作歸總分類，無需再開展其它工作。這些認識上的缺陷，導致對自然資源資產負債表的編制工作和支持力度大打折扣，即使有的地區自然資源資產負債表編寫完成了，也僅僅是自然資源資產負債表的某一部分，不系統也不全面，難以落地。

(2) 自然資源資產產權不夠清晰

區域自然資源資產負債表的編制受邊界的影響，我們所說的自然資源資產負債表是指一定區域的自然資源資產，這裏的一定區域可以是行政邊界，也可以是自然地理邊界，主要是指被評價的自然資源資產管理單位所管理的自然資源資產。根據我國當前資源環境條塊管理的狀況，對黨政領導幹部進行自然資源資產離任審計更重要的是確定自然資源資產管理單位的管理邊界。當前，我國自然資源資產的產權和責任均不够清晰，要進行黨政領導幹部自然資源資產離任審計，就需界定自然資產的邊界，界定被評價單位各類自然資源資產的所有權和管理權，明確各類自然資源資產的責任，否則將影響自然資源資產負債表的建立和黨政領導幹部自然資源資產管理的責任追究。

(3) 缺少有關的技術標準

當前，僅有森林生態系統服務功能、海洋生態資本評估有相應的核算評估規範或導則可參考，各地區試點開展的負債表研究大部分是參考1997年Constanza發表在國際《自然》雜志上的文章和聯合國千年生態系統評估報告成果，並沒有一套完整的自然資源資產價值核算的體系與技術標準可供參考。如何將自然資源的數量和質量轉化為價值，也缺乏轉化的質量價格體系作為支撐。如果無法明確自然資源資產的質量與價值量之間的相互關係，則不能準確地核算出自然資源資產的價值。

(4)缺少自然資源資產基礎數據

編制自然資源資產負債表的過程發現，各類自然資源資產管理部門及各級政府對自然資源資產基礎數據掌握得極其有限，數據缺失情況非常嚴重，開展數據普查是一項迫在眉睫的工作，這很可能也是我國其它地區編制自然資源資產負債表普遍存在的問題。為此，在編制自然資源資產負債表的同時也亟需開展數據采集工作。根據深圳市自然資源資產負債表編制過程的做法和當前自然資源資產負債表編制存在的問題，提出如下建議以供參考。

(1)樹立自然資源資產保護的責任意識

剔除或淡化個人政績意識，牢固樹立保護自然資源人人有責的權責意識，將自然資源資產管理納入日常管理工作，尤其應將資源環境保護、維持、恢復改造納入黨政領導幹部行政決策全過程。深入貫徹落實《黨政領導幹部生態環境損害責任追究辦法(試行)》，强化領導幹部對自然資源資產的管護責任，時時警醒，並呼籲全社會參與和監督。

(2)加快開展自然資源資產確權登記工作

加快推進水流、森林、山嶺、草原、荒地、灘塗、沙灘、濕地、城市綠地等自然生態空間的統一確權登記，劃清自然資源資產的產權歸屬，明確自然資源資產的責任主體，實現對自然資源資產的有效監管和保護。

(3)建立自然資源資產負債表協調聯動工作機制

建立區域主要領導牽頭的跨部門的自然資源資產負債表聯動協調工作機制。建議由地區發展改革、規劃國土、財政、市場監管、環保、水務、林業(城管)、海洋、統計等單位聯合開展自然資源資產負債表，並建立自然資源資產管理協調聯動工作機制和常態化工作機制。

(4)建立自然資源資產核算技術標準體系

為使自然資源資產負債表研究工作能够能順利開展，確保編制工作的規範性和統一性，亟需建立自然資源資產負債表編制規範(含質量價格體系)，有效指導各層級自然資源資產負債表編制工作。

(5)開展自然資源資產數據資料普查

在建立自然資源資產管理協調聯動工作機制基礎上，加强相關單位的溝通協調，將各類數據采集工作納入日常工作範圍。開展相關自然資源資產的調查研究，建立完善的數據采集渠道，搭建自然資源資產信息共享平臺，構建常態化數據采集工作機制。

(葉有華，深圳市環境科學研究院生態所所長／深圳市自然資源資產核算與評估中心主任；E-mail：15889614246@126.com)

文章來源：葉有華。以兩山理論為指導，探索編制自然資源資產負債表。中國生態文明，2015，3:35-39

香港的全面水資源管理

陳漢輝博士工程師
水務諮詢委員會主席
漢臻顧問有限公司董事總經理

全球不少地方都面對水資源緊張問題，加上近年的氣候變化、難以預測的持續大旱，令這情況更見嚴峻。香港政府一直就本港未來的水資源管理作長遠規劃，以應對氣候變化帶來的挑戰，並於2008年推行《全面水資源管理策略》(《策略》)，提倡「先節後增」策略。前者利用各項節約用水的措施控制用水需求的增長。而後者透過發展海水化淡、再造水、以及洗盥水回用和雨水集蓄，逐步將現時三個水源(包括本地收集的雨水、輸入的東江水和沖廁用的海水)擴展至六個水源的供水佈局，加強香港的供水安全及應變能力。

節約用水

在用水需求管理方面，水務署以多元滲透、軟硬兼備的方式，推動節約用水。軟件方面，水務署推出了多項針對性措施，推廣節水文化，增加公眾對水資源及節約用水的認識，鼓勵市民更主動地在日常生活中節約用水。當中包括於2012年12月設立臨時「水資源教育中心」以加強向年輕一代宣傳節水訊息。水務署亦正就於2018/19年度啟用新的永久性水資源教育中心進行設計工作。新中心將可介紹更豐富的水資源內容給更廣泛的參觀者。為了增進年青一代對水資源及節約用水的知識，水務署於2015/16學年為小學生開展了「惜水學堂」教育計劃，以結合知識理論和實踐執行，加強學童對保護水資源和全球水資源問題的認識，鼓勵他們在學校和家中實踐節約用水的理念，並向朋輩、家人，以至社區推廣節水信息。計劃現有超過170間小學參與。小學層面以外，水務署正計劃再進一步發展幼稚園適用的教材套。水務署亦將節約用水的宣傳教育工作從學校延展到社區，於2014年3月推出了「齊來慳水十公升」運動推廣節約用水，並向參加的住宅用戶派發節流器。此外，水務署也為公共屋邨、政府建築物和學校安裝節流器，並為非住宅界別的高用水量商界行業編寫最佳實務指引。水務署將於2016年11月舉行節約用水週，匯聚教師、學生、環保人士、政府部門、業界代表及市民參與，推廣攜手節水的訊息。

硬件方面，水務署除了計劃強制新發展項目及大型樓宇翻新項目使用已在「用水效益標籤計劃」內登記的節水器具，亦有推行多項工程計劃，致力減少水管滲漏及爆裂。

漏損管理

香港地勢多山，為向高地的居民提供足夠的供水，位於低地的水管往往須要長期承受極高的水壓。而交通繁忙，以及在擠迫的地下空間鋪設及維修其他公用設施，均令香港的配水網絡更容易有較高滲漏率和更多水管爆裂問題。雖然挑戰重重，但水務署在2015年大致完成為期15年的更換和修復老化水管計劃，並配合主動滲漏控制和快速維修等措施，將水管滲漏率由超過25%的高峰降至現時的15%。

隨著近年感應器、遙測、管網管理軟件及數據分析的科技進步，水務署正逐步建立智管網(WIN)，以便更有效率地實行管網管理。透過設立監測區域(DMAs)及在管網中安裝高科技監測和感應設備，水務署可收集及分析數據，持續監察管網的健康狀況，制定最符合成本效益的措施以維持管網的健康狀況。此外，水務署亦會發展相關的分析工具，例如預測水管爆裂的模型，以加強智管網的功能。

開拓新水源

為應付氣候變化對水資源的影響，本署積極開拓一些不受氣候變化影響的新水源，包括海水化淡、再造水、洗盥污水回用及雨水集蓄等。

首先，在海水化淡方面，水務署已確立在將軍澳興建一所中型海水化淡廠的可行性，並於去年11月已為將軍澳海水化淡廠展開設計工作。該廠將採用逆滲透技術，食水產量為每日13萬5千立方米，其後可擴展至每日27萬立方米，供應本港百分之五至十的食水用量。

在再造水方面，水務署正計劃在新界東北部地區(包括粉嶺和上水)，利用石湖墟污水處理廠的排放水，進一步處理成為再造水，用於區內沖廁及其他

非飲用用途。相關設計、財務、法律框架等方面的研究已開展，預計可於2022年開始逐步供應再造水至上水及粉嶺。水務署亦會繼續研究在其他未有海水沖廁的地區，引入再造水的可行性。

此外，政府亦於合適政府新發展項目中建設洗盥水及集蓄雨水作非飲用用途，以推廣使用有關系統。水務署已制定相關的技術和水質標準，並提供在政府處所再用洗盥水及雨水的詳細指引。

展望未來

水務署現正進行顧問研究檢討《策略》。檢討範圍包括評估現行水資源管理措施的成效、預測至2040年的長遠用水需求及供應，以及建議新的水資源管理措施，為應付難測的氣候變化和挑戰作好準備。

政府長遠的目標是將現時三管齊下(本地收集的雨水、輸入的東江水和沖廁用的海水)的供水模式，透過發展海水化淡、再造水、以及洗盥水回用和雨水集蓄，逐步轉化為六個水源的供水網絡，加強香港的供水安全及應變能力。水務署亦會繼續推動節約用水，以期達至有效率和可持續地運用水資源，並透過成立智管網維持高質網絡管理。

氣候變化背景下廣東近10年冷冬頻發成因分析
Analysis of the reasons of cold winters in Guangdong for the past decade during global climate change

郝全成　杜堯東　胡婭敏　王娟懷　李芷卉
（廣東省氣候中心，廣州 510080）
Hao Quancheng, Du Yaodong, Hu Yamin ,Wang Juanhuai, Li Zhihui
(Guangdong Climate Center, Guangzhou, 510080)

引言

聯合國政府間氣候變化專門委員會(IPCC)于2013年發布的第5次評估報告認為，1880-2012年的130年間全球地表平均氣溫上升了大約0.85℃，且1983-2012是1400年來最熱的30年，科技部2015年發布《第三次氣候變化國家評估報告》則指出1909年以來中國的變暖速率高于全球平均值，在每百年升溫0.9℃到1.5℃之間。但是這些報告都沒有明確回答廣東氣溫尤其是冬季氣溫是什麼樣的變化趨勢？

廣東地處華南，北依南嶺被屏障，冬季多氣候溫暖。然而最近10年，令公眾印象深刻的極端寒冷事件頻頻發生，先是2008年初遭遇了百年不遇的極端雨雪冰凍灾害，2016年1月超級寒潮又橫掃廣東，潮州等12個市縣極端最低氣溫破歷史極值，南粵大地的人們紛紛穿起棉衣禦寒，廣州城區更是建國以來第一次錄得降雪。事實提醒我們，在全球氣候變化的背景下，最近10年廣東冷冬正變得越來越頻繁，因而有必要分析其成因。

1　資料和方法

氣象觀測站搬遷記錄來自廣東省探測數據中心。1951-2015年冬季氣溫站點觀測資料均來自廣東省氣候中心。再分析資料為NCEP逐日2.5×2.5格點資料。本文方法主要為相關分析、EOF分解、合成分析等。2006年冬季為2006年12月-2007年2月，其餘年份冬季以此類推。

2　冬季氣溫基本特徵

2.1 廣東冬季氣溫的空間分布特徵

為了研究1951-2015年來廣東冬季氣溫的空間分布特徵，對其進行EOF分析，得到前4個模態方差貢獻率(表1)，其中第一模態占總方差的88.49%，反映廣東冬季氣溫的變化特徵為全省一致性。第二特模態占總方差的2.60%，表徵了廣東冬季氣溫呈南北反位相變化特徵。第一特徵向量相應的時間係數(圖1)與廣東86個氣象站的冬季平均氣溫變化的相關係數達0.965。因此，可以認為，廣東冬季氣溫變化以全省一致為最重要的特徵，廣東冬季平均氣溫就可以很好代表全省範圍各站點的氣溫變化及其異常，在冬季氣溫分析和預測中可以當作一個整體看待。

表1 1951-2015年廣東冬季平均氣溫EOF分析4個模態方差貢獻和累計方差貢獻

模態	方差貢獻率(%)
第一模態	88.49
第二模態	2.60
第三模態	1.83
第四模態	1.44
累計貢獻率	94.37

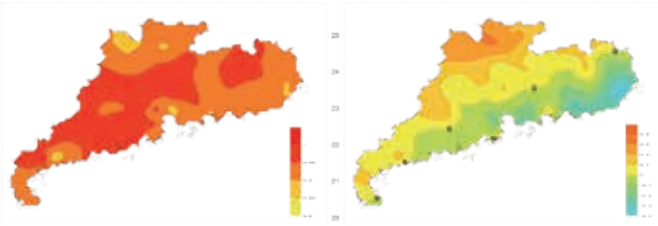

圖1 1951-2015年廣東冬季平均氣溫EOF分析第一模態(左)和第二模態(右)

2.2 廣東冬季氣溫年代際變化特徵及冷冬、暖冬劃分

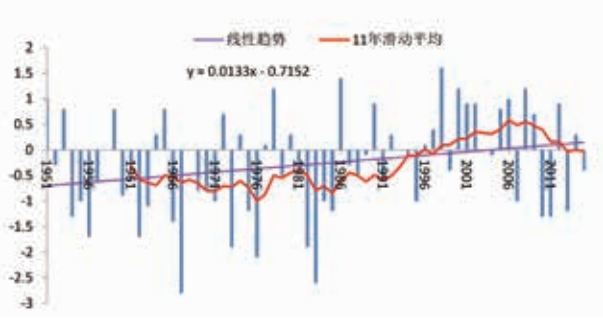

圖2 1951-2015年廣東省冬季氣溫距平變化

從年代際背景看，上世紀50-80年代中期，廣東冬季氣溫處在一個年代際偏低的背景下，上世紀80年中後期至本世紀前10年處在一個年代際偏暖的背景下，從11年滑動平均趨勢看，2006年開始的近10年我省冬季平均氣溫出現下降趨勢，可能意味著自1980年代以來的升溫趨勢有所減緩或者終止，這是個非常值得引起預報員關注的信號。綫性趨勢分析表明，大約每10年上升0.13℃，但顯著低于全國冬季氣溫增速（0.23/10a）。

圖2分析表明，1951-2015年廣東冬季氣溫距平的標準差為1，因此，我們定義大于等于一個標準差為暖冬、小于等于一個標準差為冷冬，按此標準，廣東暖冬年7年：1951年、1978年、1986年、1998年、2000年、2006年、2008年，冷冬年有21年：1954年、1956年、1962年、1963年、1966年、1967年、1972年、1973年、1971年、1973年、1975年、1976年、1982年、1984年、1983年、1985年、1995年、2007年、2010年、2011年、2013年。1951-2105年的近65年間，廣東冷冬年數是暖冬年數的3倍，近10年冷冬年數是暖冬年數的2倍（4個冷冬、2個暖冬）。分析還表明，廣東冷冬年主要出現在20世紀80年代中期前和近5年，而暖冬主要出現在20世紀80年代中期後至本世紀前10年，也表明廣東的冷暖和暖冬變化存在强烈的年代際特徵。

3 冬季氣溫與海溫、環流的關係

大氣運動的原理告訴我們，由于太陽輻射對地球大氣加熱的不均勻性，北極或者歐亞洲高緯地區盛行下沉氣流，容易導致冷氣團堆積形成冷高壓，累積到一定程度，由于氣壓梯度力作用導致冷氣團向南（中低緯）爆發，形成强冷空氣或者寒潮，從而易導致氣溫偏低。前一節分析表明，近10年廣東錄得4個冷冬年，根據大氣運動原理，我們首先想到的是北風應當是偏强的，那麽事實如何？我們合成的近10年冬季徑向風（南風為正、北風為負）顯示（圖3），廣東上空被顯著的北風正異常控制，這是正是環流導致氣溫偏低甚至到達冷冬標準的最直接因素。

進一步分析顯示，圖3的貝加爾湖至蒙古附近也同樣存在顯著的北風正異常，而該地區恰好大致位于西伯利亞高壓（40°~60°N；80°~120°E）監測區範圍。圖4表明近10年西伯利亞高壓處于年代際偏强的背景下，有利于冷空氣活動南下影響廣東。那麽，我們就想知道是什麽導致以西伯利亞高壓為代表的東亞冬季風從年代際偏弱轉為年代際偏强？一般認為，海洋作為氣候系統的緩變因子對大氣環流有著較强的外强迫作用，其通過海-氣相互作用尤其是感熱和潛熱的異常，可使大氣環流發生異常，作為能驅動大氣環流10年尺度轉折且目前能廣泛被氣象學界認知的主要就是PDO。作為北太平洋海溫演變的主要模態，PDO對ENSO年際變化、我國氣候的年代際變化有著重要的調製作用。梁蘇潔（2014）、丁一匯（2014）研究表明，東亞冬季風的年代際變化與大氣環流和太平洋海表溫度（SST）的區域模態變化密切相關。當北半球環狀模/北極濤動（NAM/AO）和太平洋年代際振蕩（PDO）處于負（正）位相，東亞冬季風偏强（弱），中國冬季氣溫偏低（高）。監測表明（圖略），PDO自2000年左右轉為負位相並持續了近15年（有可能持續更長），廣東省冬季氣溫的11滑動平均下降趨勢恰好開始于2006年，這與丁一匯（2014）認為氣溫年代際轉折要滯後PDO位相轉變6年左右相吻合。同時廣東冬季氣溫與PDO相關關係（圖5）分析也印證了上述觀點。

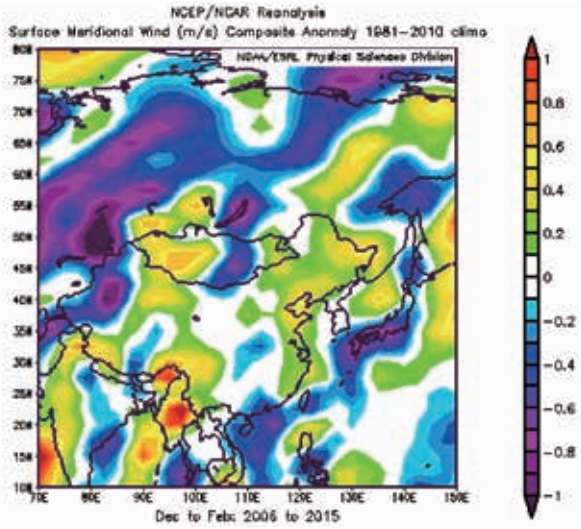

圖3 2006-2015年地表平均徑向風合成

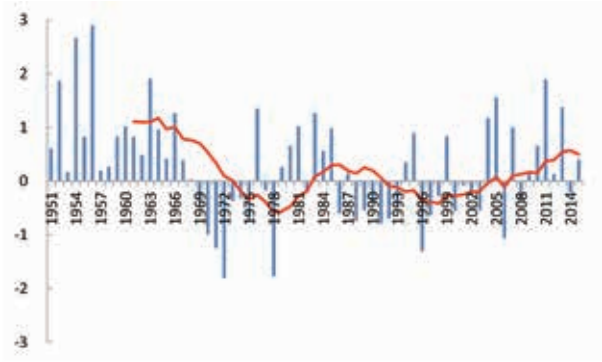

圖4 1951-2015年西伯利亞高壓指數變化(紅色為11年滑動平均)

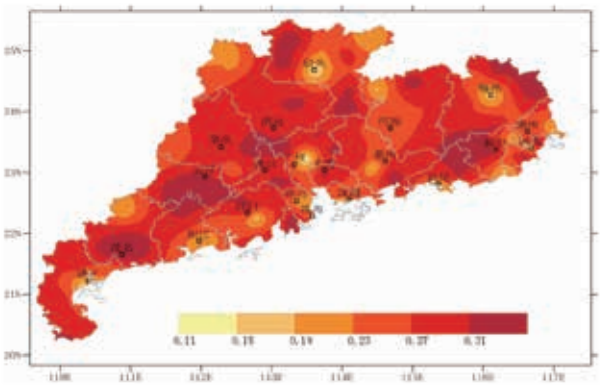

圖5 1951-2015年廣東冬季氣溫與PDO指數相關分布(通過0.05顯著性檢驗)

4 冬季氣溫與遷站的關係

進入21世紀後，我省進入經濟快速發展的新階段，大規模的城市化導致許多觀測站的觀測環境已經不符合地面氣象業務觀測規範，不少站點進行了搬遷以符合觀測業務規範。據統計，近15年來我省有55個(表2)市(區)縣實施了搬遷，占總數的64%，表2可以看出尤其是2007年以來我省站點搬遷出現了加速趨勢，達到4.4個/1年，比前5年遷站速率快了1倍。

新站點基本上都位于郊區，同時原址一般都變為自動觀測站以方便做對比觀測或轉為其他特殊氣象觀測。我們發現，遷站後所有站點冬季氣溫都出現了明顯下降，為簡便起見，我們以廣東傳統的韶關、廣州、深圳、湛江4個代表站點(傳統代表站汕頭尚未遷站)來定量分析遷站造成的我省冬季氣溫變化，其中韶關代表了粵北山區、廣州代表了粵中地區(珠三角)、湛江代表粵西地區、深圳代表沿海地區。表1表明，我們選定的4個代表站遷站起始年份各不同，按先後順序分別是：湛江(2004年)、深圳(2007年)、韶關(2010年)、廣州(2011年)，為數據合理和便于比較我們選定2011年為4個代表站對比觀測起始年，其對比觀測數據見表3。表3表明，4個代表站占遷站後5個冬季氣溫均出現明顯下降，從高到低依次為：韶關下降1.4℃、廣州下降0.9℃、湛江下降0.9℃、深圳下降0.4℃，從而容易計算出4個代表站代表的全省冬季平均氣溫下降了0.9℃，這就是導致最近10年頻頻錄得冷冬記錄的重要因素。

表2 近15年來我省氣象觀測站遷站統計分析

年份	站名	遷站數(個)
2016	廣寧、高要、博羅、惠來、海豐	5
2015	郁南、鶴山、樂昌	3
2014	乳源、龍門、恩平	3
2013	仁化、南雄、龍川、梅縣、潮州	5
2012	南海、惠陽、新興、信宜	4
2011	五華、遂溪、吳川、澄海、翁源、花都、廣州	7
2010	連山、羅定、四會、韶關、佛岡	5
2009	連南、雷州、從化、連州、英德、新豐	6
2008	開平、揭西	2
2007	廉江、懷集、蕉嶺、電白	4
2006	斗門、深圳、中山	3
2005	三水	1
2004	陽江、湛江	2
2003	番禺、徐聞、東莞	3
2002	茂名、紫金	2
		總計：55

表3 廣東4個代表站2011-2015年冬季氣溫（單位：℃）對比觀測分析

年份	韶關		差值	廣州		差值	深圳		差值	湛江		差值	平均
	新	舊		新	舊		新	舊		新	舊		
2011	9.2	10.5	-1.3	13.1	13.7	-0.6	15.1	15.3	-0.2	15.3	16.2	-0.9	
2012	11.4	12.8	-1.4	15	16	-1	17.2	17.7	-0.5	17.2	18.2	-1	
2013	9.9	11.3	-1.4	12.6	14	-1.4	15.3	15.9	-0.6	15	16	-1	
2014	11.8	13.2	-1.4	14.1	15.2	-1.1	16.4	16.7	-0.3	16.4	17.4	-1	
2015	10.8	12.1	-1.3	13.6	14.1	-0.5	15.6	16.2	-0.6	15.9	16.6	-0.7	
平均			-1.4		-0.9			-0.4				-0.9	-0.9

5 冬季氣溫與氣候平均值變動的關係

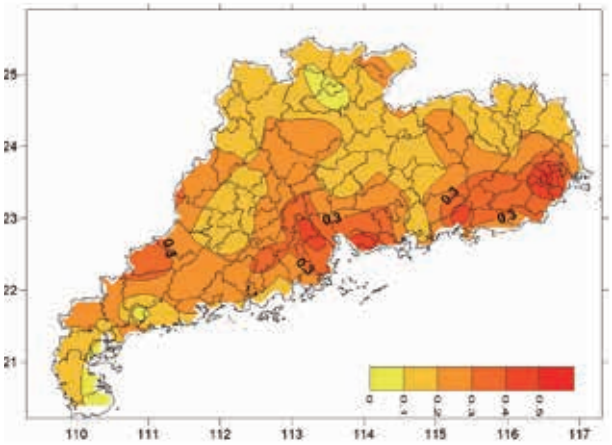

圖* 全省站點氣候平均值變化分布（1981-2010減1971-2000）

根據國家氣候中心現行業務標準，為更好地體現氣候變化的年代際背景，氣候平均值每10年更新一次，因業務切換需要時間緩衝，2012年才開始啓用1981-2010年氣候平均值。據計算，1981-2010年全省冬季平均氣溫14.2℃，比1971-2000年13.9上升了0.3℃。從新舊氣候平均值對比的空間分布上看，采用新氣候值後，我省上升最為明顯的主要位于珠三角及粵東地區。氣候平均值的提高相當于改變了每年冬季氣溫的比較對象，在合適的海溫外强迫及大氣環流異常的情況下，極易記錄到我省冬季氣溫偏低。

6 結論與討論

（1）廣東1951-2015年冬季氣溫分析表明，廣東冬季平均氣溫增速為0.13/10a，但近10年冬季平均氣溫呈明顯下降趨勢。

（2）本研究定義了我省冷冬、暖冬劃分標準，發現近65年冷冬年數（21年）是暖冬年數（7年）的3倍，近10年我省有4年屬冷冬年份，2年屬暖冬年。

（3）PDO年轉為負位相導致的以西伯利亞高壓為代表的冬季風增强，近15年全省55個站點搬遷帶來的累積影響是冬季器測氣溫下降的重要人為因素，新氣候平均值（1981-2010）的啓用，三者共同作用使得我省冬季更容易達到冷冬標準。

本文僅分析初步分析了導致冷冬的海溫外强迫因子，雪蓋、海冰等外强迫因子有待于進一步研究。此外，冷冬年份也有乾冷和濕冷之分且濕冷的冷冬往往更大，為更好研究冷冬發生規律，也有必要將來開展更細緻的分析。

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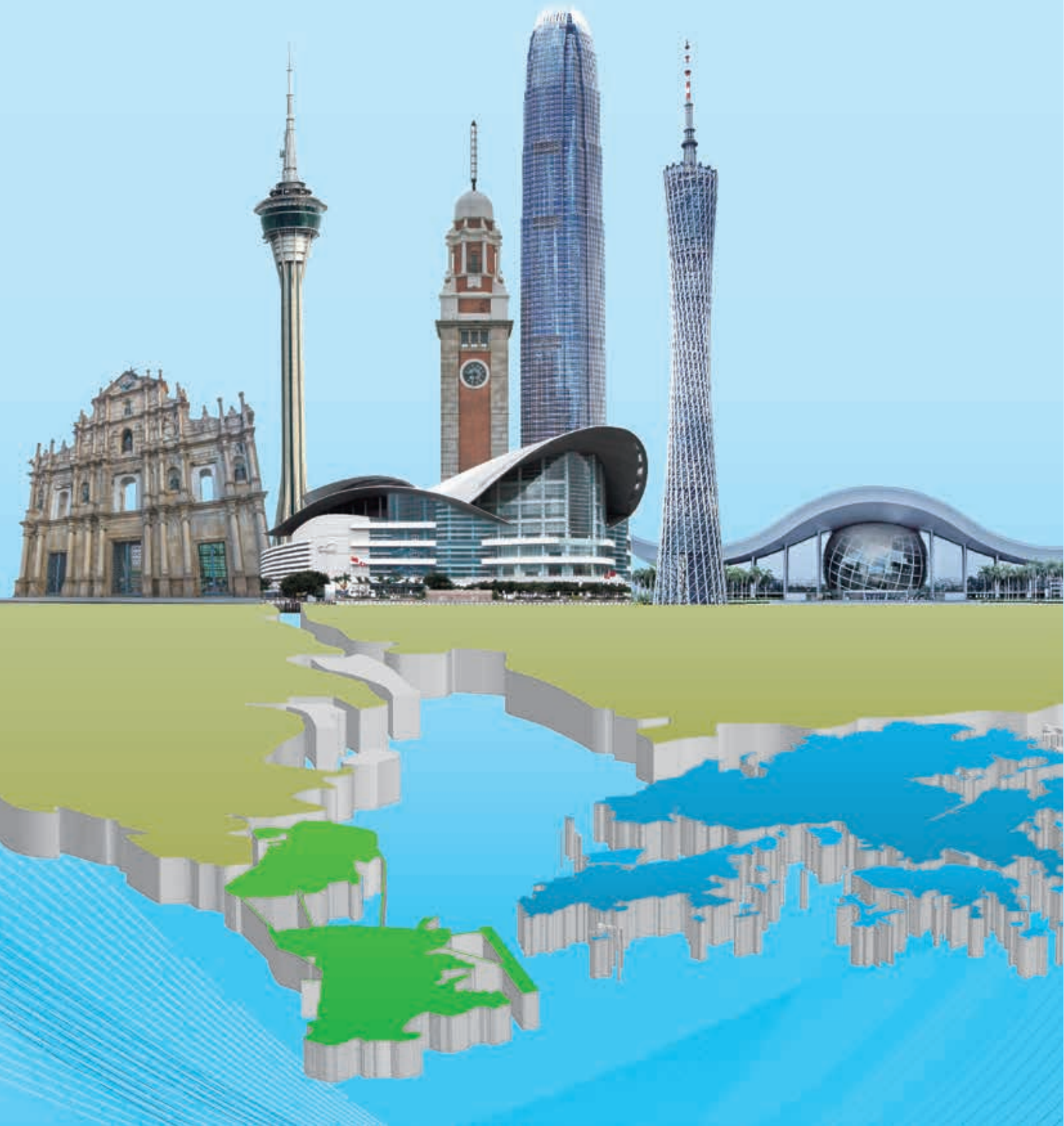

徵文集投稿名單

編號	地區	論文題目	作者
1	香港	The use of sustainability rating schemes to deliver better infrastructure projects	Mr Chris Broadbent
2	香港	Improving air quality of Pearl River Delta Region Beyond 2020	Kenneth K M Leung
3	廣東省	淺談農業旅遊的基本內涵	羅凱
4	廣東省	借簽泉州先行區經驗加快佛山“海上絲路”建設	葛振海
5	廣東省	基於制度溢出視角下的廣東自貿區南沙片區與香港的整合培育機制研究	陳德寧
6	廣東省	智慧城市背景下上海智慧社區發展路徑創新研究	紀江明
7	廣東省	基於WRF模式和測風塔的風資源評估	李霽杭、郭振海
8	廣東省	珠三角近地層CO2通量模擬分析與評估驗證	麥博儒
9	廣東省	2014年珠海大氣CO2濃度變化及軌跡傳輸分析	邵應泉
10	廣東省	深圳市雷電活動、災害情況及防禦措施分析	曾慶鋒
11	廣東省	廣州市甲流流行的氣象因數與時空傳播風險	段海來
12	廣東省	珠三角區域大氣聯防聯控治理前景模擬評估	王楠
13	廣東省	廣東大鵬半島資源環境承載力評估研究	孫芳芳
14	廣東省	廣東省環境保護產業發展現狀及建議	李鴻濤
15	廣東省	廣東省環境治理服務業發展狀況淺析	朱潔靜
16	廣東省	基於情景分析的廣東省建築節能減排潛力研究	郭洪旭
17	廣東省	快速城市化區域經濟與環境協調發展動態評價	葉有華
18	廣東省	城軌行業建設階段BIM應用問題思考	劉鐵民
19	廣東省	基於城市景觀環境下的車輛段設計-以廣州地鐵為例	唐薇
20	廣東省	綠色智慧建築綜合施工技術	譚國輝
21	廣東省	珠三角地區地下空間開發的主要岩土工程問題研討	林本海
22	廣東省	現代有軌電車軌道結構技術創新研究和運用	羅信偉
23	廣東省	廣東省珠三角區域外向功能結構演化研究	王萌
24	廣東省	2006-2014年粵港澳珠江三角洲區域空氣污染物比較研究	湛社霞
25	廣東省	珠三角地區城市旅遊經濟與交通時空耦合協調分析	鄭秋霞
26	廣東省	大亞灣不同海洋功能區表層海水無機碳體系的研究	韓婷婷
27	廣東省	Studies on Charges for Sea Area Utilization Management and Its Effect on the Sustainable Development of Marine Economy in Guangdong Province, China	楊黎靜
28	廣東省	廣東省海水養殖貝藻類碳匯潛力評估	齊占會
29	廣東省	深圳灣海岸帶景觀格局變化研究	羅豔

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30	廣東省	港珠澳大橋主體工程建設期中華白海豚保護管理實踐初探	冼憲恒
31	廣東省	海洋生物體內砷及其形態研究新進展	張黎
32	廣東省	廣東海洋可持續發展對策建議	黃良民
33	廣東省	軌道交通建築優質設計探索	葉凱倫
34	廣東省	服務“一帶一路”政策溝通的粵港澳灣區聯動發展研究	艾德洲
35	廣東省	綠色投資基金的投資策略分析	盧禹
36	廣東省	“一帶一路”與大灣區的能源可持續發展的挑戰與對策	鐘世川
37	廣東省	廣州中小學生課餘參與垃圾分類社會實踐的調研與建議	嚴俊松、嚴凱
38	廣東省	粵港澳大灣區助推“設施聯通”的路徑選擇	王麒麟
39	廣東省	農民生活與活動鑒賞問題研究	羅凱
40	廣東省	水文循環模擬中下墊面參數化方法綜述	趙玲玲
41	廣東省	廣東省能源消費碳排放影響機理分析-基於IO-SDA模型	王長建
42	廣東省	城鄉生活圈規劃與建設方法芻議	劉雲剛
43	廣東省	2000-2010年中國城市土地利用環境效益變化及其驅動力	宋小青
44	廣東省	廣州城市暴雨內澇時空演變及建設用地擴張的影響	趙耀龍
45	廣東省	Investigating Low-carbon Crop Production in Guangdong Province, China (1993-2013): A Decoupling and Decomposition Analysis	甄偉
46	廣東省	提升廣東海島生態保護研究能力的對策建議	陳海亮

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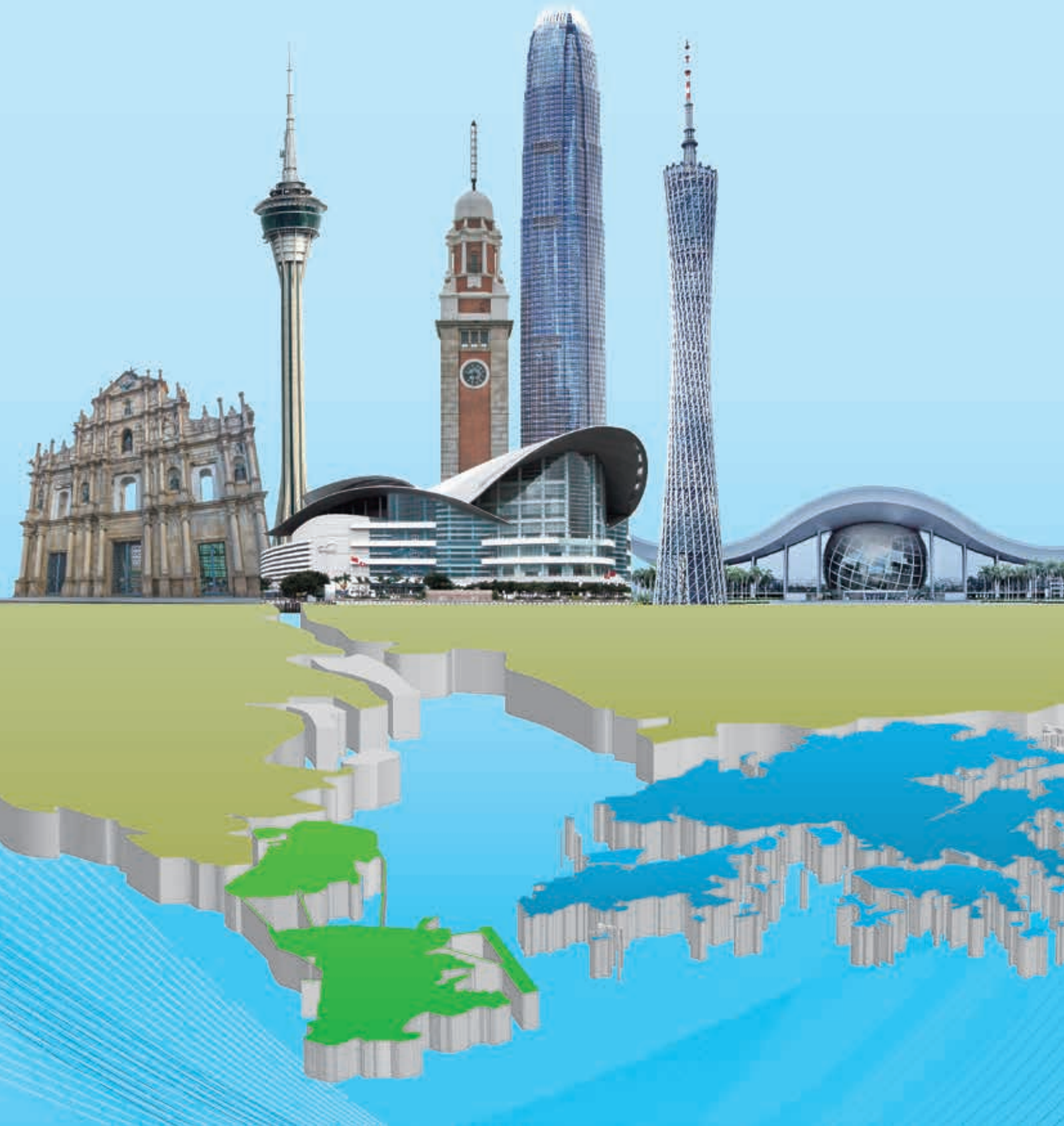

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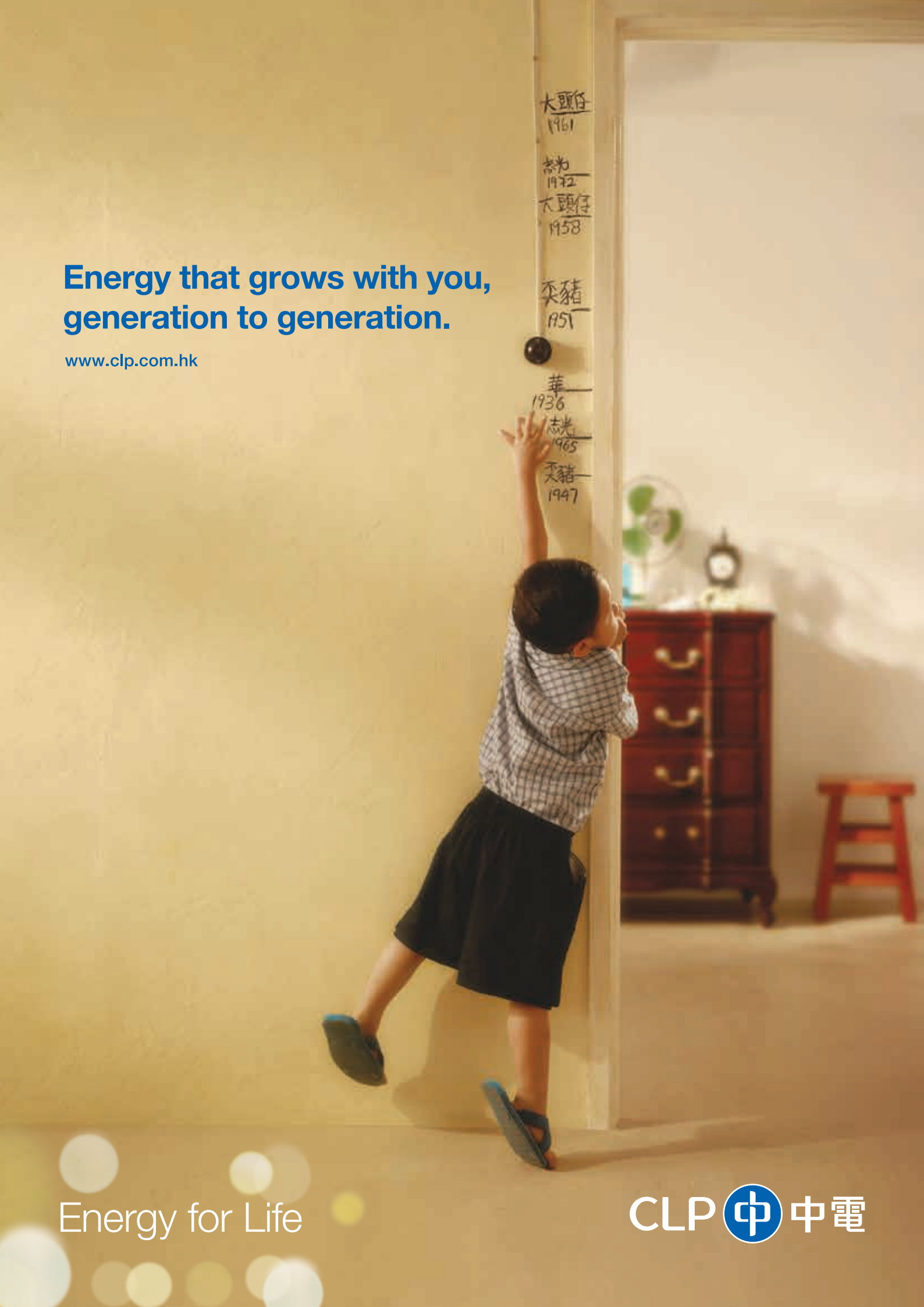

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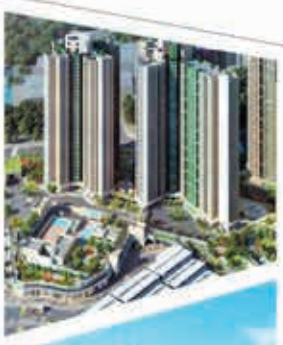





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Selection of Venue

1) Preference is given to a venue that has adopted green initiatives in their operation including but not limited to the following:
   a) Energy efficient facilities;
   b) Recycling programme;
2) The venue is easily accessible by public transportation to promote the use of mass transportation by the attendees.

Event Promotion

1) Communication and promotion of the event are by emails and e-channels; ✔

Printing of Materials

1) Handouts are minimised and optimized; ✔
2) E-version is available ✔

Food and Beverage Selection and Arrangement

1) Communication is made with attendees ahead of time about tea breaks and with helpers and speakers about lunch to ensure proper portions are served; ✔
2) Non-disposable glasses/cups instead of bottled drinks are served – drinks are refillable by pitchers; ✔
3) The caterer provides Chinaware for coffee breaks. Table cloth is not used; ✔
4) The size and type of food provision is carefully planned to avoid food surplus. Low carbon menu is provided. ✔

Reuse and Recycle

1) Name badge holders are reused.
2) Recycling boxes (for attendees), in particular paper, are provided throughout the venue; ✔
3) Edible food from leftovers, if any, are either taken away or donated to Food Angel, towards zero food waste disposal to the maximum extent possible. ✔

Event Execution

1) Indoor air temperature is maintained rom 23 to 260C, as arranged with property management; ✔
2) Lights are switched off at appropriate places to minimise energy consumption, as arranged with property management; ✔
3) Computer presentation only (flipcharts are not used); ✔
4) Announcement of green initiatives is made by the Master of Ceremony; ✔
5) Volunteers are recruited to monitor green activities on the date of the event; ✔

Carbon Reporting and Audit

1) A Report on carbon emission of the event is referenced to Guidelines to Account for and Report on Greenhouse Gas Emissions and Removal for Buildings (Commercial, Residential or Institutional Purposes) in Hong Kong – 2010 Edition by EPD and EMSD;
2) The Report is reviewed and audited by a Certified Carbon Auditor;
3) The results of carbon auditing is to be published online.

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