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Meeting financial challenge facing China's Sponge City Program (SCP) – Hong Kong as a gateway to green finance

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ABSTRACT

China's Sponge City Program (SCP) envisions a city's surface water management system to function like a sponge to absorb, store, infiltrate, and purify rainwater, and release it for reuse when needed. It emphasizes the use of natural and natural-engineering hybrid measures to mimic natural water cycle, thus offers Nature-Based-Solutions (NBS) to urban surface water management. The SCP has become a flagship sustainability program, applied across 30 pilot cities in mainland China since 2014. Significant progress has been made with three years of start-up financial support from the central government. At present, securing adequate financial resources to support further construction, operation, and maintenance of relevant green/blue infrastructures becomes the key challenge to extending the SCP within pilot cities and to other cities. Green finance, referring to local, national, or transnational financial investments from public, private, and alternative sources flowing into environmental and sustainability initiatives, has been experimented in the EU member countries and identified as one of the key business models to NBS, could be a viable solution to further the uptake of China's SCP concept and its implementation. In this context, the emergence of Hong Kong as an Asia-Pacific green finance hub offers a gateway for the SCP to secure financial resources. This paper describes the financial challenge of the SCP and the emerging development of green finance in China and compares it with the EU's experience in NBS green finance. It then explores how Hong Kong could take advantage of its well-established international standards and favourable geopolitical position as a key financial hub to channel green capital into China's SCP from interested investors. To do so requires overcoming current barriers in financial regulations and jurisdictional regimes between mainland China and Hong Kong. A stable and transparent cross-border green finance platform should be established to actively engage investors interested in the SCP and other green projects, so as to accelerate China's transition towards its goal of ecological civilisation and sustainable development.

1. China's Sponge City Program

Worldwide climate change coupled with accelerated urbanisation has led to substantial changes in all sectors of urban socio-ecological systems, and also brought about many serious environmental problems (Fang et al., 2009; [1,2]). The increase in the number and intensity of extreme storm events, together with the replacement of vegetated surfaces by impervious pavements, plus a reliance on highly-engineered

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urban drainage systems, has made urban flood risks a key challenge facing human society in the twenty-first century ([3,4]; Yin et al., 2021). International records reveal a significant increase in flood losses over time. It has been estimated that globally, financial losses due to flooding exceed US $100 billion per year [5]. Due to its fast-paced urbanisation, insufficient flood protection measures, and limited capacity of obsolete urban drainage systems (grey infrastructure commonly designed for 1:1 or 1:3-year rainfall events), China has witnessed the most devastating urban flood disasters in the last decade [6–9]. For instance, urban flooding in Beijing on 21 July 2012 claimed 79 deaths and caused an economic loss estimated at about US $1.6 billion [10]. Similar urban flood disasters occurred in Ningbo and Shanghai in 2013, Guangzhou in 2014, 2015, and 2016, Shenzhen and Wuhan in 2016 [6,11], and most recently Zhengzhou in 2021.

To tackle this widespread environmental problem and safeguard citizens' welfare, the concept of the Sponge City was officially put forward by President Xi Jinping at the Central Urbanisation Working Conference in December 2013 [6,7]. The Sponge City Program (SCP) then became a key national strategy to achieve sustainable urban growth and "*Ecological Civilisation*", an innovative development paradigm signifying ecologically sustainable modes of natural resource utilisation [12], and ultimately build a "well-off society" [7]. The SCP envisions a city's water management system to function like a sponge (a highly porous structure) to absorb, store, infiltrate, and purify rainwater, and release it for reuse when needed [13,14]. It leverages the use of natural blue (such as urban rivers, streams, wetlands, and ponds) and green spaces (such as rain gardens, green roofs, bioswales, and greenbelts) as natural and natural-engineering hybrid measures to mimic natural water cycle such as soil percolation and bio-filtration, and address urban flooding and mitigate the adverse effects of urban development. In essence, it offers a Nature-Based-Solution (NBS) to urban surface water governance. As increasingly promoted and widely experimented across the member countries of the European Union (EU), NBS is conceptualized as various interventions that are supported and/or inspired by diverse forms of nature, to address social/environmental/economic challenges and improve sustainable livelihoods [15–17]. NBS offers an umbrella concept that covers a wide range of approaches which involve not only the utilization of natural components such as soil, water and vegetation, but also innovative governance, institutional, business, and finance models (via leveraging both public and private funding) for harnessing the power of nature to turn environmental, social and economic challenges into opportunities [18]. Thus, China's SCP is inherently a type of NBS, specifically focusing on urban flooding management, which can learn and borrow valuable experience from NBS experimentation and implementation in other countries, so that further uptake of SCP concept and its wide application in China and beyond can be encouraged.

A distinctive characteristics of China's SCP is the integration of NBS with traditional grey (engineering-oriented) infrastructure. It thus highlights a transition from traditional hard engineering-focused solutions relying on grey infrastructure (e.g. flood defence measures, dams, pipes, and drainage systems) to a systematic integration of hybrid systems. This comprises synergistic combinations of grey, green, and blue infrastructure assets to mitigate urban flooding and water pollution and provide co-benefits of improved economic vibrancy, ecological restoration, and resilience, and social welfare [1,19–23]. This Sponge City strategy represents not only an ecological friendly approach in urban water management [24–26] but also an enormous undertaking intended to promote ecological civilisation and urban sustainability [23,27].

Sponge City construction guidance was issued by China's central government (e.g. via Ministry of Housing and Urban-Rural Development, Ministry of Finance, Ministry of Water Resources, etc.) in 2014, after which over 500 cities applied to be pilot SCP cities. Thirty were selected, 16 in the first batch in 2015 and another 14 in the following year [7,13,27]. These pilot cities include megalopolises (Beijing, Shanghai, Tianjin, and Shenzhen), second and third-tier cities (such as Zhenjiang, Changde, and Qingyang), extend across different climate zones (cold/hot, humid/arid), with varied biogeographical conditions (forest, meadow, steppe, mountainous, coastal, lowland), and experience different urban sustainability and water management issues [7,13,28,29]. They thus display a range of contexts making them suitable for experimenting with an array of SCP measures and initiatives, so as to accumulate experience and learn lessons for a nationwide SCP implementation.

To support the experimentation of innovative SCP measures in these pilot cities, the central government and relevant authorities allocated 400-600 million RMB (around US$60-90 million) to each city for its first three years of SCP construction and operation for initiating some pilot projects (mostly at small-scale and site-specific level) [30]. Beyond this start-up financial support, financial responsibility for SCP implementation rests fully on the pilot cities themselves, and they are encouraged to raise funds through public-private partnerships (PPP) and other financial ventures [13]. Undoubtedly, with the strong policy support from the central government and the provision of start-up funding, the SCP is gaining momentum [13,31]. SCP design and construction guidelines have gradually become established through the pilot programme. Some exemplary applications of green/blue infrastructure (such as artificial rainwater wetlands, infiltration ponds, biological retention facilities, and water-permeable paving) have been successfully constructed in pilot cities.

However, the initial funding from the central government is obviously insufficient for SCP implementation at a large scale [29]. A recent survey of seven pilot cities revealed that investment from central and local governments accounted for only about a third of the total SCP construction costs (operation costs were excluded from the survey), with the remainder having to come from PPP and long-term bank loans [31]. Fig. 1 shows the funding portfolio of a total of 455 SCP projects in Wuhan city, one of the SCP pilots. In Wuhan's PPP, private investors are more willing to be engaged in small-scale water supply and wastewater treatment facilities [32], instead of other green infrastructures which have mostly intangible values (for example, green parking, green roofs, rain gardens and so on). The interest and enthusiasm of local private investors in investing in SCP projects tends to wane due to the difficulty in guaranteeing performance, the financial risk taken, and the revenues that can be generated from their investments [24,33,34], as well as dissipating distrust between local governments and private investors [31,35].

A recent estimate shows that the average cost of SCP projects lies between 100 to 150 million RMB per km^2 (which varies according to location, materials, labour, and technique), without considering land prices (the average land price in 2019 was about 2500 RMB/m^2 for all prefecture and above cities, according to China Land and Resources Almanac, 2020) and retrofit costs (e.g. road disruptions and relocations) [21,35]. SCP implementation at larger scales (such as the whole city and the entire catchment) would require substantial investment [24,29]. In this regard, financial constraints (shortage of funding and market incentives) would greatly impede SCP implementation, which commonly has high uncertainty over life-cycle maintenance costs and project cost-effectiveness [13,36]. While technical solutions have been gradually advanced, unfortunately, very limited financing and funding options besides PPP are currently considered to further the uptake of SCP concept and its successful implementation. Thus, securing substantial finance from non-governmental sectors has become a critical challenge facing all cities that wish to implement the SCP and become sponge cities [13,27,32,34].

2. Green Finance-A Way Forward

Green finance, which has been growing worldwide in recent years, is defined in various ways (Table 1), usually according to the underlying motivation of the financing institution [37]. Even though there is no single universally accepted definition, it refers broadly to local, national,

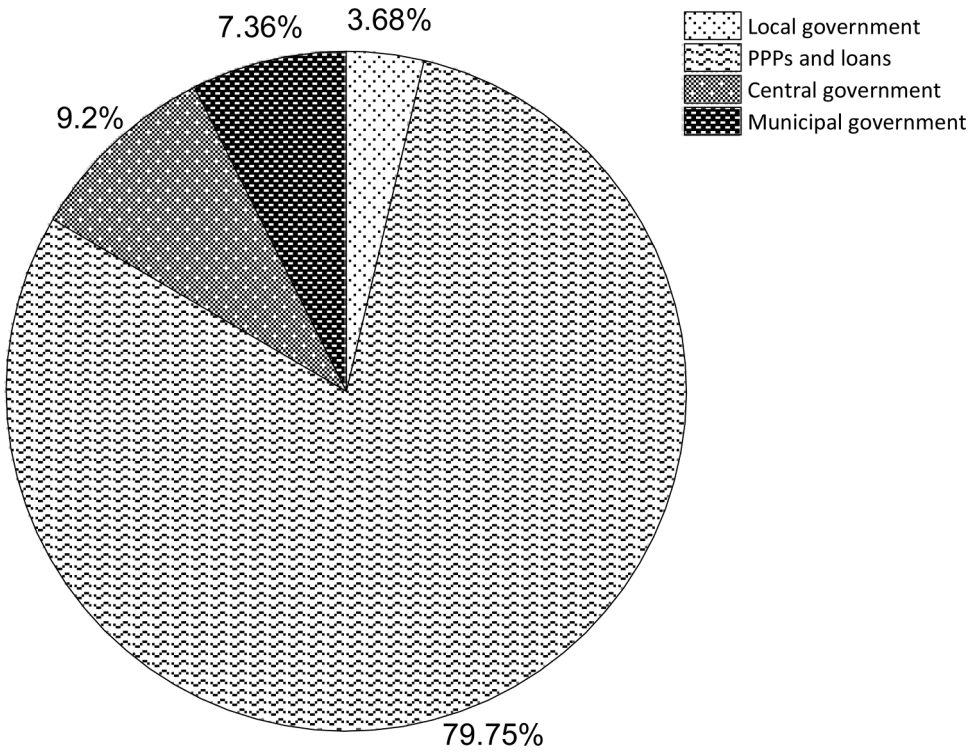

Fig. 1. SCP investment scheme in Wuhan (Source: [31]).

or transnational financing (investments and loans) drawn from public, private, and other alternative sectors to support environmental/ecological programs and sustainable initiatives [38–40]. Green finance integrates environmental benefits with economic profits, increases access to finance for public environmental/ecological goods and alleviates financial demands on local governments who are usually responsible for environmental management. In particular, it has been experimented and demonstrated as one of the financing instruments and business models in support of NBS [41,42]. Learning from the experience of NBS financially supported by various green financing instruments, it is expected that green finance could serve as a viable solution to close the gap between current financing levels of SCP and what is required to meet the long-term SCP development objectives and realize the SCP potentials [39].

2.1. Green finance in mainland China and green financing instruments for NBS

China, now the second-largest economy in terms of GDP, suffers severe environmental degradation which seriously harms public health, in turn, threatens future economic prosperity [47–49]. To halt environmental degradation and pollution, as well as restore ecological resilience, China's central government has been actively promoting green development [50–52]. With a paradigm shift from the traditional development pattern to ecological civilisation (China's innovative path towards sustainable development), various approaches have been proposed since the early twenty-first century, including clean production, environmental taxation, circular economy, and most recently, green finance [53,54].

China is now vigorously promoting green finance system [40,54,55] and developing financial instruments (including securities, products, or services) to create win-win solutions that generate both environmental benefits and economic profits [56]. Green finance emphasises environmental interests and serves as a new engine for promoting environmental initiatives and a green/circular economy [53,57]. In August 2016, the People's Bank of China, along with six other ministries and commissions, issued "Guidelines for Establishing the Green Financial System", which clarifies that the green finance system aims to mobilise and incentivise more private capitals to invest in green/environmental sectors [46]. In October 2017, green finance was specified as a key task of the financial service industry in the country's 13th Five-Year (2016-2020) Strategic Development Plan [47,57].

China has become the largest green finance market worldwide [58]. By the end of 2020, outstanding green loans had reached 11 trillion RMB (about US$1.8 trillion), and green bonds had reached about 1 trillion RMB (about US$190 billion) [59,60]. China is thus currently the world's leading green investment destination [52]. Under the supervision of the People's Bank of China and the National Development and Reform Commission, issuers of green bonds (and other green financing instruments) are required to invest in projects that fall under one or more of the following categories: energy saving, clean energy, clean transportation, pollution prevention and control, resource conservation, and recycling, and ecological protection and climate change adaptation [61,62]. Taking advantage of this green finance availability, some SCP pilot cities (and other cities actively engaged in SCP initiatives) have started experimenting with different green finance schemes, including but not limited to green loans and green bonds (Table 2). For example, Shenzhen (one of the SCP pilots) has planned to establish a Sponge Green Ecological Fund since 2016, aiming to leverage social capital to supplement the municipal investment in the city's SCP implementation, for which the total up-front cost is estimated at approximately US$10.8 billion [26]. Unfortunately, little progress has been made to date, and overall the progress of green finance in support of SCP development is relatively slow and limited.

In comparison, EU, the world leader of NBS implementation [15], emphasizes the co-production and co-benefit of NBS financing by multiple investors and beneficiaries [18,70,71]. A series of innovative financial solutions (i.e., various green financing instruments) and associated business models have been experimented for various NBS initiatives [42]. There is an array of financing instruments available from public, private, and blended funding sources, through different pathways like green bunds, loans, credit lines and green microfinance, to

Table 1
Definitions of green finance.

Organization	Definition	Source
World Economic Forum	Green finance refers to structured financial activity devoted to improving environmental outcomes.	[43]
Asian Development Bank	Green finance is investment or lending considering environmental effects and sustainability.	[39]
G20 Green Finance Study Group	Green finance is financing of investments that can provide environmental benefits in the broader context of environmentally sustainable development.	[44]
Organisation for Economic Co-operation and Development (OECD)	Green finance is activity that simultaneously achieves economic growth and environmental protection (e.g. pollution and GHG emissions reduced, improved efficiency of natural resource use).	Inderst et al., 2012
European Union	Sustainable finance is interchangeably used with Green finance and refers to the process of taking due account of environmental and social considerations in investment decision-making, leading to increased investments in longer-term and sustainable activities. More specifically, environmental considerations refer to climate change mitigation and adaptation, as well as the environment more broadly and related risks (e.g. natural disasters). Social considerations may refer to issues of inequality, inclusiveness, labour relations, investment in human capital and communities.	[45]; [37]
The People's Bank of China	Green finance policy refers to a series of policy and institutional arrangements to attract private capital investments into green industries such as environmental protection, energy conservation and clean energy through financial services – including lending, private equity funds, bonds, shares and insurance.	[46]

support and mainstream NBS [41]. For instance, a green bond framework was issued by Lantmännen (a Swedish agricultural cooperative) in April 2021 to provide funds for protecting and restoring agricultural ecosystems and biodiversity, together with various green initiatives for sustainable land use and environmental management [72].

While it is clear that green finance offers effective ways of channelling private and public resources towards NBS, putting this broad idea into practice is not always straightforward. Particularly for China's SCP, the existence of some institutional and governance barriers have deterred social capital from entering into SCP investment and relevant green finance.

Firstly, the SCP projects are not popular with green investors as a result of dispersed and intangible benefits, such as the provision of blue-green infrastructure components for rainwater retention and simultaneously for recreation and natural amenity. These are public goods without explicit administrative regulations and mechanisms [13,73] to guarantee private investment return, thus tend to be unappealing to private investors.

Secondly, the financial track records of SCP projects are still lacking, as many SCP projects do not exist long enough to provide adequate cost and benefit information [13,74], which makes it difficult, if not impossible, for interested investors to ascertain the performance of their investments [24].

Thirdly, in comparison with traditional engineering drainage capacity enhancing projects, the up-front cost of sponge city facilities achieving the same rainwater control capacity is much higher [75], but the paybacks usually last over a long-time span. Many private investors might not be able to adequately aware of the long-term financial benefits, like accounting and reporting in financial markets tend to reward short-term over long-term investment. This is borne out by the 2020 China Green Bond Market Newsletter, which shows the most popular project categories for green finance are clean energy and clean transportation where such barriers are less evident [76].

As such, central and local governments remain the principal financers of SCP projects [59,77]. Nonetheless, institutional investors whose investment horizon is often tied to long-term liabilities (e.g., pension benefits provided at retirement) might be a capital source of financing for SCP projects. In this regard, how SCP can get access to alternative capital sources through green finance becomes critical to safeguarding the success of SCP in China.

2.2. HKSAR: the global financial centre of China and its green finance services

As China has made green finance a strategic imperative, Hong Kong has sought to take advantage of its unique geopolitical position to become the global financial centre of China as well as a leader in green finance in the Asia-Pacific region [78]. The city has been recognized unquestionably as one of the world's premier international financial centres with a long-standing reputation for transparency, reliability, and efficiency in the provision of a full spectrum of financial products/services [79,80]. Its geostrategic position in China makes it a key offshore financial gateway [81].

In response to green finance development in mainland China, Hong Kong's Financial Services Development Council (a governmental agency) took a strategic initiative in 2016 to build the city as a regional green finance hub and to support the development of a green bond market [62]. Subsequently, the Hong Kong Monetary Authority (HKMA, the de facto central bank of Hong Kong) became a member of the global Network for Greening the Financial System in 2019, showing a strategic synchronisation with the international green finance community [78]. The Centre for Green Finance was established in the same year to support green bond issuance. In the ensuing year, HKMA established the Green and Sustainable Finance Cross-Agency Steering Group, and issued the "White Paper on Green and Sustainable Banking" and "Common Assessment Framework on Green and Sustainable Banking" to reinforce green finance regulations [82]. Taken together, HKSAR is using its status as an international financial centre to promote green finance to the mainstream by creating liquidity, supporting the integrity and providing incentives for green bonds [83]. Its ambition is to become a green finance hub for the Asia-Pacific region and to engage wide investors/stakeholders so as to connect them to China's enormous green market.

The Hong Kong Quality Assurance Agency (HKQAA) has established a Green and Sustainable Finance Certification Scheme for green bond issuance, which examines and monitors whether issuers have a proper green framework in place to commit the capital of their bonds towards green projects. Meanwhile, grant subsidies, up to a maximum of US $102,000 per bond issuance, are provided to encourage green bond issuers to make use of Hong Kong's competitive capital market and professional services. These practices are designed to enhance the transparency and credibility of green financial products provided in Hong Kong, strengthen market confidence, and encourage impact investors to be involved in green finance and support green projects. As such, the Hong Kong Stock Exchange (HKEX) has become the largest listing venue for Chinese offshore green bonds. While dominated by

Table 2
Financial support for SCP projects.

Financing scheme	Example	Advantages	Disadvantages	Source
Direct investment from central government	Direct investment of 1.2-1.8 billion to each of the 30 pilot cities	• Few constraints on fund raising • Potential financial risks are shouldered by central government • Faster and direct process of selection of construction partners (no open competitive tender is required) • Effective implementation of the projects	• Lack of flexibility on investment options • Restricts the development plan in the pilot and at site-specific level (due to limited the fund size) • Covers only the first stage of the SCP, so lacks long support • Lack of plans for connection with other financial sources	Griffiths et al. [24]; Li et al. [21], Yang et al. (2020), Chan et al. [6], Xia et al. [7]
Equity/ Environmental stocks	Listed corporations in the Hong Kong Stock Exchange market	• Diversify benefits and risks • Limited cash flow requirements	• Reduced control in decision-making process and investors may have divergent views • High return rate expectations	Sina Finance, 2015
Public-Private Partnership (PPP)	Chang'an River project (2017-2020) in Dongguan city, Guangdong province. Total investment is 739 million RMB; sources of funds include project company financing and municipal government support (BOT), with 15 year contract.	• Alleviate government's financial burden • Leverage public funding • Risk sharing	• Inadequate regulations • Perceived loss of public control • Assumption that private financing is more expensive and belief that contract negotiations might be difficult • Small scale, project based	[21,63]; Fu and Guo, 2020
Green bonds	On August 5, 2019, Chongqing Nanchuan District Urban Construction Investment (Group) Co. issued a non-public green bond for SCP programs. The issuance scale is 1.08 billion with 7 year term and 7.80% issuance rate. In the same year, there existed 1 trillion RMB of green bonds issuance in China.	• Secure a steady funding stream • Relatively short maturity and high liquidity • Tax-exempt • Relatively low risk	• One-time source of funds • Each issuance requires individual's approval and full repayment • Potential charges for interest • Require repayment revenue stream • Require ahead preparation of documents at design-level • Require significant administrative efforts	Deheng [64–66]
Green credits (Loans)	Six commercial banks in Changde (a SCP pilot city) issued 3.98 billion yuan for SCP programs (January 2015 to July 2016)	• Low/no-interest financing • Creditors enjoy strong contractual enforcement rights	• One-time source of funds • Require full repayment	[66,67]
Insurance/Taxes/ General funds	Changde City Banking Financial Institutions established a sponge city fund with an amount of 1.499 billion RMB	• Consistent funding stream • Use existing managing system • A clear investment horizon tied to the long-term nature of their liabilities • Steady funding stream	• Competition for funds • Funds do not fully reflect SCP effectiveness	[66,68,69]

green bonds, other green finance products, and investment opportunities are also becoming available (Table 3).

3. Linking Hong Kong's green finance with China's SCP

Due to the long-standing institutional and informational barriers and the lack of standards consistent with those of international green finance markets, global investors have limited opportunities to access and engage substantially in mainland China's financial market [79]. The limited capital exchange flows (in and out) in China have deterred international investors from entering mainland China's financial market directly. Instead, they favour using HKSAR as a convenient gateway.

Table 3
Green finance products in Hong Kong (HKSAR).

Product	Definition	Key players	Examples
Green bonds	Financial products to finance or refinance fresh or old eligible green projects	**Issuers** include commercial banks, corporations, asset-backed security, HKSAR government, policy banks	HKSAR Government Green Bond
Green loans/ Green credits	Loan instruments available to exclusively invest or re-invest in qualified green projects	**Banks** would provide green loans or credit lines for clients or projects that are making contribution to the overall sustainable development goals of the banks	Alliance for Green Commercial Banks
Green equity investment	Investors use a range of strategies, including positive/negative screening*, ESG integration** or engagement*** strategies for making sustainable investments	**Investors** provide capital for companies that bring positive influence to environment and society. Investors can reduce their environmental risks across their portfolios.	Green Index and Green Derivatives
Green funds	These are significantly taking environmental issues into consideration in investment strategies, with ethical avoidance criteria	**Fund managers:** define specific theme for the funds and offering funding for eligible companies or projects with strong environmental credentials **Green label and certification schemes:** indicate the greenness of the funds.	Green Tech Fund

* Footnote: Negative screening allows investor to exclude companies or projects that have poor environmental, social, or governance (ESG) performance or do not follow international norms and standards; positive screening is selecting the companies or projects in the opposite manner.
** Investors may require comprehensive inclusion of ESG factors in their decisions of portfolio.
*** Investors take action to influence the behaviour of companies using shareholder rights.

Notably, Hong Kong is still the only place where Chinese currency can be exchanged freely. Moreover, the Shanghai-Hong Kong Stock Connect, Shenzhen-Hong Kong Stock Connect, and Bond Connect are fully operated, based on mutual access arrangements established between the People's Bank of China and HKMA [84]. Thus, using HKEX as a platform, qualified foreign (institutional and private) investors can easily access the mainland market through Hong Kong [85]. For example, Swire Properties Limited (listed on HKEX and London Stock Exchange) issued green bonds totalling HK$1,934 million (about US$250 million) in 2020 to support green buildings, renewable energy, and sustainable water and wastewater management in both Hong Kong and China.

Indeed, Hong Kong's green finance market is expanding and diverse financial products/instruments are available (Appendix A), demonstrating great potential for the city to function as China's principal international green finance gateway. Several water resource companies in mainland China are listed on HKEX, aiming to attract foreign investment (Table 4). Even though it is not possible to link funds raised in this way directly to SCP projects in which they are engaged, these listed companies have been active in forming PPP with local governments to finance SCP implementation. For instance, China Everbright Water (No. 14 in Table 4) has invested a total of RMB1.385 billion (about US$923 million) into the construction of blue-green infrastructure for the SCP of Zhenjiang city (an SCP pilot in Jiangsu province) since 2016, along with another RMB1.2 billion provided by the central and municipal governments. A variety of blue-green facilities have been successfully constructed, including grass swales along major streets, artificial wetlands, rain creeks, sponge parks, and drainage pumping stations. Now Zhenjiang city's grey-blue-green infrastructure can cope with heavy rainstorms that occur once in 50 years. This PPP project has won the "Building Back Better" infrastructure award conferred by the United Nations Economic Commission for Europe (https://unece.org/ppp/forum5/awards/BBBprojects). Its success suggests that SCP can be potentially financed through the route from private capital to HKEX listed companies and then various SCP projects.

Opportunities exist to use Hong Kong's green finance market to fund China's SCP projects, but this route appears under-exploited to date, in part due to the barriers discussed earlier. To conquer these barriers and realize SCP objectives, three key actions are needed.

Firstly, a suite of SCP-labelled financial products, such as bonds, loans, and funds, could be tailor-designed and issued in the HKEX, preferably with an effort to certify them using the Hong Kong Green Finance Certification Scheme. Different from the water-related mainland companies already listed on the HKEX (as per Table 4), these new financial instruments are earmarked specifically for SCP projects. These new green financial products can reach potential investors who are active in trading on HKEX. If appropriately designed, they could attract international private and institutional investors and channel capital into SCP projects directly. Institutional investors (such as pension funds and investment funds) have shown to be more environmentally concerned and are often the major source of long-term funding. These investors tend to have greater confidence in the quality of green finance products/services provided in Hong Kong [86], due to the city's adoption of common law and transparent financial regulations on par with international practices [78,85]. Availability in the HKEX market of these green financial instruments could thus leverage private investment in the SCP, and meet its need for finance from a growing supply of green capital from large international institutional investors with a significant appetite for long-term investment in environmental assets and sustainable infrastructure [87]. Extensive collaborations between the central government, Hong Kong, and mainland municipal governments are required to reduce existing barriers presented in regulations, supervision, and financial frameworks, so as to facilitate the issuance of these SCP-labelled financial products.

Secondly, a crucial step is to promote disclosure and flow of SCP information at all levels, which is essential for all interested (local and overseas) investors to adequately evaluate risks and project returns, and reduce investment uncertainty. Currently, very limited information about SCP projects, such as financial track records, and long-term environmental and economic performance data, is available [13,27,35]. Trustworthy information can help international and local investors assess the effectiveness and credit ratings of SCP-labelled financial products. If investors lack data and adequate information on SCP projects (particularly information about how exactly the procedures for financial safeguards or the environmental and social impact risk mitigation measures are applied on those projects), they will not invest.

Finally, substantial differences exist between mainland China's assessments and certification of green practices with that used elsewhere internationally, which makes it hard for third parties to evaluate enterprises' environmental performance and environmental risks [58,67]. While several SCP projects have undertaken environmental impact assessment (EIA), their social and economic dimensions have been neglected [88]. And there is a lack of generally accepted monitoring and verification standards that can assess rigorously the environmental, social, and economic performance of SCP projects. Moreover, a series of technical standards for different SCP components (such as green roofs, public parks, and green buildings) have been established, but a synergistic assessment system is still lacking [89]. The inconsistency and inadequate utilisation of relevant standards within China, and between China and elsewhere might discourage international investors since they would face difficulties in understanding the green compliance of SCP projects. A clear set of SCP standards should be developed, which should be consistent, comparable, based on reliable datasets and methodology, and aligned with legally bound and internationally-recognized green standards. Such standardisation can provide interested investors with a

Table 4
Mainland China's water management companies listed on the Hong Kong Stock Exchange (HKEX).

Number	Stock code	Stock for short	Classification	Total assets (HK$ Billion)	Revenues(HK$ Billion)	Net profit (HK$ Billion)
1	00371	Beijing Enterprises Water Group	Wastewater treatment	153.2	12.45	2.77
2	00270	Guangdong Investment	Environmental protection	-	9.49	2.69
3	01272	Datang Environment	Environmental restoration	-	2.87	0.004
4	06839	Yunnan water	Water treatment	42.23	3.04	-1.93
5	06136	Kangda Environment	Water treatment	-	1.73	2.32
6	01363	Zhongdao Environment	Water treatment	-	0.34	-0.093
7	00556	Fanya Environment	Wastewater treatment	-	0.024	-0.012
8	01129	China Water Corporation	Water treatment	-	0.533	0.043
9	00436	Xinyu Environment	Environmental protection	1.65	0.36	0.06
10	01395	Qiangtai Environment	Environmental protection	-	0.03	-0.003
11	00646	China Environmental Technology	Environmental protection	-	0.03	-0.022
12	00807	SIIC Environment	Municipal sewage treatment	32.66	2.64	0.391
13	01790	Dali Environment	Waste incineration	2.19	0.11	0.038
14	01857	China Everbright Water	Municipal sewage treatment	-	2.12	0.43

Note: Based on the closing price of each company on February 4, 2021; "-" denotes no data available.

common reference system, bolster their confidence in relevant SCP financial products, and allow them to access SCP financial products not only via HKEX but also Shanghai-Hong Kong Stock Connect and Shenzhen-Hong Kong Stock Connect.

4. Conclusion

China's SCP initiative emphasizes the use of natural and natural-engineering hybrid measures to mimic natural water cycle, thus offers NBS to urban surface water problems like waterlogging and water pollution [74]. Concurrently, it promises many additional benefits for urban residents, such as pleasant recreational venues, cooler urban temperatures, and increased biodiversity and ecological resilience [90, 91], eventually leading the country's transition toward ecological civilisation [31].

The country aims at 80% of its cities being equipped with adequate SCP infrastructure by 2030, for which the total cost for construction (with no maintenance costs being accounted for) is estimated at around EUR 1 trillion [92]. The success of China's SCP is inseparable from developing reliable and sustainable financing schemes [24,91]. Learning and borrowing valuable experience in financing NBS implementation from the EU countries, it is clear and encouraging that innovative green finance, which integrates environmental/ecological factors into financial activities, could help channel private and public resources into the SCP, so as to break the financing bottleneck threatening the wide uptake of SCP concept and the long-term delivery of China's SCP [36,56,83].

Hong Kong, a traditionally-recognized top global financial centre and newly-established green finance hub has been positioned as the gateway of China to the international capital market since the early period of its economic reform [78,79]. With its international standards and a reservoir of unrivalled professional expertise, the city contains advantages of being accessed by global market participants and trusted by the international investors, who would be interested in China's market, particularly, including SCP projects. Yet, whether and how the city's unique position and function can be maintained still contains uncertainties, facing the fact that the newly enacted National Security Law has affected the status of HKSAR in the eyes of western countries and western investors [85], and its global financial linkages withering with foreign capital and market institutions walking away from the city [79].

Nonetheless, Hong Kong has withstood the ravages of social protests in 2019, the passage of National Security Law, and the COVID pandemic in 2020, and maintained high standards of public governance and a fair environment that most international investors are highly valued [85]. More importantly, China's central government has reaffirmed its commitment to keep Hong Kong as the country's international financial centre, which could guarantee the potential role of Hong Kong to serve as an immediate zone between the international world and the mainland as well as a gateway to channel green capital from impact investors into various SCP projects to accelerate China's transition towards its goal of ecological civilisation and sustainable development.

Declaration of interests

The authors declare that they have no known competing financial and other conflict of interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.nbsj.2022.100019.

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