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**Green cities and
the challenge
towards climate
change**

An analysis of Singapore's
sustainable urbanism

Supervisor

Ch. Prof. Stefano Soriani

Assistant supervisor

Ch. Prof. Rosa Caroli

Graduand

Emma De Marchi
Matriculation number
864521

Academic Year

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TABLE OF ABBREVIATIONS

AA Council:	Active Ageing Council
ABC:	Active, Beautiful, Clean
ACE:	Action Community for Entrepreneurship
ALS:	Area Licensing Scheme
ASEAN:	Association of Southeast Asian Nations
AVA:	Agri-Food Veterinary Authority
BCA:	Building and Construction Authority
BRI:	Belt and Road Initiative
C2E:	Community Emergency and Engagement
CCAS:	Closed Containment Aquaculture System
CCCA:	Centre for Climate Crime Analysis
CCCs:	Citizens' Consultative Committees
CCMCs:	Community Club Management Committees
CCRS:	Centre for Climate Research Singapore
CCs:	Community Clubs
CCUS:	Carbon Capture, Utilisation and Storage
CEVS:	Carbon Emissions-based Vehicle Scheme
CIB:	Community-in-Bloom
CO₂:	Carbon Dioxide
COE:	Certificate of Entitlement
COP:	Conference of the Parties
CPF:	Central Provident Fund
CSC Council:	Community Sports Clubs Council
CSCs:	Community Sports Clubs
CSF:	Centre for Strategic Futures
DSDG:	Division for Sustainable Development Goals
DTSS:	Deep Tunnel Sewerage System
EAP:	East Asia and Pacific
ECHR:	European Convention on Human Rights
EDB:	Economic Development Board
EMPACT:	European Multidisciplinary Cooperation Platform Against Criminal Threats
EPA:	Environmental Protection Agency

EPM: Environmental Planning Management

ERP: Electronic Road Pricing

ESS: Energy Storage System

EV: Electric Vehicles

FDI: Foreign Direct Investment

GDP: Gross Domestic Product

GFA: Gross Floor Area

GHG: Greenhouse Gases

GIC: Government Investment Corporation

GLCs: Government-Linked Companies

GROs: Grassroots Organisations

HDB: Housing and Development Board

HDR: Human Development Report

IAECC: Indian Activity Executive Committees Council

ICAO: International Civil Aviation Organisation

ICC: International Criminal Court

ICLEI: International Council for Local Environmental Initiatives (Local Governments for Sustainability)

ICT: Information and Communication Technology

IES: International Enterprise Singapore

IGBP: International Geosphere-Biosphere Programme

IGO: Intergovernmental Organisation

IMCCC: Inter-Ministerial Committee on Climate Change

IMF: International Monetary Fund

IMO: International Maritime Organisation

IoT: Internet of Things

IPCC: Intergovernmental Panel on Climate Change

IPRA: International Peace Research Association

KPIs: Key Performance Indicators

KTPH: Khoo Tech Puat Hospital

LA21: Localising Agenda 21

LEDS: Low-Emissions Development Strategy

LNG: Liquefied Natural Gas

LPAA: Lima-Paris Action Agenda

LRT: Light Rapid Transit
LTA: Land Transport Authority
MELS: Mandatory Energy Labelling Scheme
MENA: Middle East-North Africa
MEPS: Minimum Energy Performance Standards
MESRA: Malay Activity Executive Committees Council
MET: Mass Engineered Timber
MOE: Ministry of Education
MoU: Memorandum of Understanding
MRT: Mass Rapid Transit
NASA: National Aeronautics and Space Administration
NAZCA: Non-State Actor Zone for Climate Action
NBC: National Biodiversity Centre
NCs: Neighbourhood Committees
NDCs: Nationally Determined Contributions
NEA: National Environment Authority
NGO: Non-Governmental Organisation
NParks: National Parks Board
NTU: Nanyang Technological University
NUS: National University Singapore
OECD: Organisation for Economic Cooperation and Development
PA: People's Association
PAP: People's Action Party
PAYM: People's Association Youth Movement
PCN: Park-Connector Network
PM: Prime Minister
PPS: Principal Private Secretaries
PPVC: Prefabricated Pre-finished Volumetric Construction
PSA: Port of Singapore Authority
PTC: Public Transportation Council
PUB: Public Utilities Board
R&D: Research and Development
RCs: Residents' Committees
RN Council: Residents' Network Council

RN: Resident's Network
ROK: Republic of Korea
RSA: Resource Sustainability Act
SCP: Sustainable Cities Programme
SDGs: Sustainable Development Goals
SGBC: Singapore Green Building Council
SGBMP: Singapore Green Building Masterplan
SGP: Singapore Green Plan
SIA: Singapore Institute of Architects
SID: Sustainable Infrastructure Development
SOM: Skidmore, Owings & Merrill
SS: Smart State
SSTEC-AC: Sino-Singaporean Tianjin Eco-City Administrative Committee
SSTEC: Sino-Singaporean Tianjin Eco-City
SSTs: Sea Surface Temperatures
UCLG: United Cities and Local Governments
UHI: Urban Heat Island
UN-Habitat: United Nations Human Settlements Programme
UN: United Nations
UNCC: United Nations Climate Change
UNDESA: United Nations Department of Economic and Social Affairs
UNDP: United Nations Development Programme
UNECE: United Nations Economic Commission for Europe
UNEP: United Nations Environment Programme
UNESCO: United Nations Educational, Scientific and Cultural Organisation
UNFCCC: United Nations Framework Convention on Climate Change
UNOPS: United Nations Office for Project Services
URA: Urban Redevelopment Authority
VQS: Vehicle Quota System
WCR: Walk-Cycle-Ride
WEI: Water Efficiency Index
WELS: Water Efficiency Labelling Scheme
WEMP: Water Efficiency Management Plans
WHO: World Health Organisation

WIN Council: Women's Integration Network Council

WRI: Water Resources Institute

WSSD: World Summit for Social Development

WTO: World Trade Organisation

WWF: World Wildlife Fund

ABSTRACT

Questo lavoro si propone di rispondere ad una domanda precisa, ovvero se la progettazione, lo sviluppo e la creazione delle città eco-sostenibili sia un mezzo di contrasto alla più grande sfida che al giorno d'oggi si scontra con noi esseri umani, il cambiamento climatico. In questa tesi, il termine *Green City* farà quindi riferimento a questo potenziale mezzo che abbiamo a disposizione per opporci ai fenomeni climatici avversi, causa di morti precoci, migrazione, decrescita economica e finanziaria e disuguaglianza sociale. L'obiettivo di questo elaborato è dunque quello di determinare quali siano le motivazioni legate a questa mia tesi, per cercare di dare una risposta e un contributo, tra i molteplici, alla questione del cambio climatico.

Il lavoro è suddiviso in due sezioni principali, più nello specifico una sezione dedicata alla descrizione, allo studio e all'analisi dell'impatto del cambiamento climatico sulle città, prendendo anche in considerazione i problemi generici relazionati all'incidenza climatica sugli esseri umani. Inoltre, verrà spiegato nel dettaglio il concetto di *Green City*, la sua evoluzione temporale, i suoi criteri di sviluppo, quali sicurezza per la popolazione, prevenzione dell'inquinamento, sistema infrastrutturale efficiente, gestione delle risorse, urbanismo sostenibile e ruolo della tecnologia, ma anche alcuni limiti, da non tralasciare. La seconda sezione è invece indirizzata ad uno specifico caso studio di urbanismo verde, ovvero quello della città-stato di Singapore. È stata scelta come modello per poter arrivare ad una conferma della mia tesi, poiché presenta molti limiti a livello geografico, ma è riuscita a sfruttare questi ultimi al meglio, fino a raggiungere la nomea di *Garden City*. In questa sezione sarà quindi esaminata nel dettaglio la città-stato, partendo dalla sua nascita fino al suo evolversi in città ecologica. Per arrivare alla conclusione che Singapore è effettivamente una città sostenibile, nonostante abbia ancora molti passi da compiere, è stato preso in considerazione il *Climate Action Plan* di Singapore, piano climatico più recente (2016) che si propone una serie di importanti obiettivi da raggiungere entro il 2030, anche per poter soddisfare i requisiti degli obiettivi di sviluppo sostenibile delle Nazioni Unite entro quell'anno (*UN SDGs Agenda 2030*).

La necessità di sviluppare una tesi di questo genere, legata ad un tema tanto attuale ed importante così come fragile e pericoloso, è nata dalla volontà e dal bisogno allo stesso tempo di esprimere un'opinione personale e di trovare almeno una risposta all'attuale crisi che colpisce tutti noi senza differenze geografiche, economiche e sociali. Ho trovato una soluzione nell'urbanismo sostenibile, sebbene ci siano ancora molti gradini da

superare e molti limiti, in alcuni casi. È fondamentale però affermare che le città sono il luogo dove tutti noi passiamo la maggior parte del nostro tempo, dove si sviluppano le infrastrutture, le tecnologie, le imprese e le industrie; è quindi un imperativo al giorno d'oggi renderle il più possibile verdi e vivibili, per far fronte ai problemi legati al clima. Stando anche a quanto stipulato durante gli accordi della Conferenza degli Stati Membri (*COP26*) di Glasgow da poco giunti al termine, azzeramento delle emissioni nette di anidride carbonica a livello globale entro il 2050, limitazione dell'innalzamento delle temperature a +1,5°C, salvaguardia di habitat e comunità naturali, maggiore cooperazione internazionale sono tra i più importanti obiettivi che i leader mondiali si sono preposti. La mia convinzione parte dal fatto che sono le città a porre le basi per il raggiungimento di tali obiettivi, poiché è proprio quello il centro delle maggiori attività economiche, industriali e sociali, e, soprattutto, dove si concentra la maggior parte della popolazione facendo seguito ai crescenti livelli di urbanizzazione.

L'analisi proposta comincia con la descrizione dei fenomeni più avversi relazionati al cambio climatico, considerando i loro effetti sulle persone, sulle città e, in particolare, sul modo di vivere nelle città. È noto come la maggior parte dei cambiamenti che stiamo osservando, dal XX secolo fino al giorno d'oggi, in maniera sempre più frequente e aggressiva, sono principalmente causati dall'azione umana su larga scala. Soprattutto, l'utilizzo del combustibile fossile è la principale causa del danneggiamento atmosferico, seguito da un aumento delle temperature della superficie terrestre e da un incremento dei livelli di inquinamento dell'aria, dovuto a smog o piogge acide. I motivi sono svariati, poiché anche gli eventi naturali possono causare effetti disastrosi, per esempio forti piogge, periodi di siccità, temporali, che si possono verificare in modo più o meno intenso dipendentemente dalla zona geografica. Secondo la *NASA*, il cambiamento climatico è definito come “un cambiamento a lungo termine nei modelli meteorologici medi che sono arrivati a definire i climi locali, regionali e globali della Terra. Questi cambiamenti hanno una vasta gamma di effetti osservati che sono sinonimi del termine”. Secondo degli studi condotti dalla *NASA*, è stato stimato che il 2016 e il 2020 sono stati gli anni più caldi, mentre, dall'inizio del XXI secolo, il livello di riscaldamento non ha mai smesso di alzarsi.

Molti sono stati gli approcci multilaterali concernenti il cambiamento climatico globale, partendo dalla Convenzione sul Cambiamento Climatico delle Nazioni Unite del 1992, la cosiddetta *UNFCCC*, o meglio conosciuta sotto l'appellativo di *Earth Summit* a Rio de Janeiro. Questa Convenzione rappresenta la base per gli accordi presenti e futuri, come il

Protocollo di Kyoto del 1997, le Conferenze degli Stati Membri, le cosiddette *COP*, la conferenza sul clima di Doha del 2001, e gli importantissimi Accordi di Parigi del 2015. Sfortunatamente, la velocità del cambio climatico nell'espandersi negli ultimi vent'anni, a causa del continuo aumento delle emissioni di gas serra, ha dimostrato l'insufficienza degli sforzi internazionali nel superare il problema a livello globale. Per questo motivo, l'impegno delle città sotto questo aspetto è fondamentale. Secondo il *C40 Cities Climate Change Leadership*, infatti, le città rappresentano la chiave per affrontare il problema del cambiamento climatico. Le ragioni sono semplici: le città sono sempre state il centro dell'innovazione, per cui hanno il potenziale per migliorare e cambiare il mondo. Le azioni a livello locale, a volte, possono determinare migliori risultati di quelle a livello internazionale. Una grossa collaborazione tra le città aderenti al gruppo *C40* sta attualmente facendo la differenza nel miglioramento dell'azione climatica, iniziando proprio dalle città e dal piano urbano. Infatti, le città rappresentano il nostro presente e il nostro futuro, facendo seguito alla previsione del Dipartimento di Affari Economici e Sociali delle Nazioni Unite (*UNDESA*) che la maggior parte della popolazione mondiale vivrà in spazi urbani (entro il 2050, più del 68% della popolazione mondiale vivrà in città). Dunque, è necessario che le soluzioni per la mitigazione e l'adattamento al clima inizino proprio lì.

Obiettivo indiretto di questo elaborato è anche quello di creare una connessione tra umanità e città, poiché il design ambientale ha proprio l'obiettivo di creare migliori condizioni di vita per le persone, oltre che contribuire alla riduzione di emissioni di CO₂. Dunque, la chiave per una progettazione efficiente di una città verde è anche quella di creare un legame tra persone e natura.

È risultato fondamentale spiegare il significato del termine *Green City*, la sua evoluzione nel tempo e le sue implicazioni. Il termine *green* è usato per fare riferimento ad una molteplicità di concetti, come il bisogno di proteggere il nostro ecosistema dai rischi ambientali che ci circondano o come efficienza delle risorse, per esempio. *Green* acquisisce un significato ampio, che varia dal livello ambientale, come la gestione dei rifiuti e il riciclo, l'uso dell'energia, la costruzione di edifici sostenibili ed infrastrutture, la gestione delle risorse naturali, al livello manageriale. Secondo quanto affermato dagli accademici Harvey e Pow, le città verdi sono luoghi il cui obiettivo è quello di raggiungere "una situazione *win-win*, un futuro gestibile e uno sviluppo prospero con piuttosto che contro la natura". La necessità di sviluppare le città sostenibili è quindi nata dal proliferarsi delle crisi climatiche, dai rischi per la salute delle persone, dai livelli molto

alti di urbanizzazione e da problemi relazionati alla sicurezza. Il termine *Eco-City/Green City/Sustainable City* è recente e risale alla metà degli anni '70 del XX secolo, quando i movimenti ambientalisti stavano nascendo negli Stati Uniti d'America. Agli inizi del XXI secolo, il bisogno di costruire città ecologiche si è fatto sempre più una realtà quasi inevitabile. Le conferenze internazionali delle Nazioni Unite e gli accordi multilaterali sul clima focalizzano sempre di più la loro attenzione sul ruolo delle città nel contrastare il riscaldamento globale e i conseguenti rischi ambientali.

Al giorno d'oggi, l'Asia è un esempio da seguire per quanto concerne la crescita esponenziale e lo sviluppo delle città eco-sostenibili. La ragione è molto semplice: oltre che essere un continente generalmente avanzato a livello tecnologico, il rapido processo di urbanizzazione del XXI secolo e il conseguente tenore di vita crescente hanno spinto alcune città asiatiche a diventare esempi di *green growth*, innanzitutto adottando soluzioni energeticamente efficienti per poter minimizzare l'uso dell'energia primaria. Inoltre, secondo il politologo Parag Khanna, l'Asia è nel procinto di diventare un super potere globale. Sia geograficamente parlando, in quanto è il più esteso tra i continenti, che in termini economici e politici, rispettivamente perché la Zona Economica asiatica rappresenta il 50% del PIL mondiale e due terzi della crescita economica globale, e perché la forma di governo tecnocratica sta avendo la meglio sulla democrazia tipica del mondo occidentale. L'implementazione di politiche sostenibili all'interno delle città implicano sforzi maggiori, poiché i governi devono riformare le istituzioni, rafforzare le capacità e i piani energetici e di *governance* climatica, ma alcune città asiatiche non si sono fermate di fronte a questo problema, cercando di sfruttare al massimo le loro potenzialità. Come ho già accennato precedentemente, l'esempio di Singapore è un prototipo di trasformazione verde da seguire a tutti gli effetti. La città-stato iniziò ad includere l'agenda verde all'interno del suo piano urbanistico subito dopo l'acquisizione dello status di città-stato indipendente nel 1965, mettendo in relazione la vita urbana con la natura e l'ambiente. Dunque, già nei primi anni di vita di Singapore, Lee Kuan Yew, l'allora Primo Ministro, propose varie campagne volte allo sviluppo di spazi verdi all'interno della città, facendo trasparire quindi la predisposizione di tale centro urbano alla crescita in chiave sostenibile. Singapore potrebbe sembrare un candidato improbabile per la pianificazione verde, in quanto si è industrializzata rapidamente e ha a disposizione un numero limitato di risorse naturali. Ciononostante, il governo ha approfittato di questa situazione vulnerabile per adottare, nel 1992, il primo *Green Plan (The Singapore Green*

Plan 2012), seguito successivamente da diversi altri piani volti sempre più alla sostenibilità e all'innovazione.

La ragione fondamentale per cui Singapore si è sviluppata in questo modo è rappresentata dalle sue condizioni precarie date dalla sua piccola estensione e dalla sua posizione che la rende vulnerabile, in quanto si trova in un'area di trasbordo di fronte allo Stretto di Malacca. Presenta dunque il rischio di essere attaccata da eventuali terroristi oppure di risentire delle crisi finanziarie ed economiche sia regionali che globali. Per questo motivo, Singapore ha dovuto svilupparsi in maniera *smart* e *green* per cercare di sopravvivere agli shock globali, in particolar modo al cambiamento climatico. Questo è il suo punto di forza. Inoltre, Singapore fa leva sulla sua *governance*; infatti, il potenziale di questa minuta città-stato proviene dalla sua leadership tecnocratica, basata su meritocrazia e utilitarismo. La perseveranza, assieme alla dinamicità e allo spirito innovativo dei capi di governo, da Lee Kuan Yew a Goh Chok Tong fino all'attuale Primo Ministro Lee Hsien Loong, ha portato la città-stato verso il successo. Attualmente, Lee Hsien Loong sta cercando di rendere Singapore sempre più sostenibile per raggiungere gli obiettivi dell'Agenda 2030. L'expertise di Singapore ha reso questa città un centro globale di esportazione di conoscenza e talento, diventando un modello per il mondo, soprattutto per la sua vicina Cina. Infatti, il progetto di collaborazione tra Cina e Singapore si è dimostrato nella creazione della città ecologica di Tianjin, in Cina. Quindi, tale progetto verrà analizzato nel seguente lavoro per aumentare la consapevolezza dell'interesse cinese verso il modello di Singapore.

In ultimo luogo, verrà considerato il *Climate Action Plan* già sopracitato. Quest'ultimo rappresenta il più recente piano d'azione climatica della città-stato, se non il più innovativo. Singapore si è proposta di rispettare specifiche misure entro il 2030, in particolare quelle di trasformare la città in un'area efficiente in termini di carbonio, riducendo le emissioni del 36% sotto i livelli del 2005 e stabilizzandoli per raggiungere gli obiettivi preposti entro quell'anno. Le quattro strategie principali riguardanti le emissioni verteranno sul miglioramento dell'efficienza energetica, sulla riduzione di emissioni di carbonio dagli impianti di produzione elettrica, sullo sviluppo di tecnologie innovative a basse emissioni, e soprattutto sulla mitigazione delle emissioni attraverso l'azione collettiva del governo e delle sue agenzie, dei cittadini, delle imprese e industrie, e della comunità in generale. L'Alto Ministro e Coordinatore della Sicurezza Nazionale Teo Chee Hean, Presidente del Comitato Interministeriale sui Cambiamenti Climatici (*IMCCC*), affermò che "Singapore prevede di ridurre ulteriormente l'intensità di

emissioni come parte degli sforzi internazionali per affrontare il cambiamento climatico. Per un paese molto piccolo con opzioni energetiche alternative limitate, la stabilizzazione delle emissioni con l'obiettivo di raggiungere un picco intorno al 2030 richiede sforzi seri da parte di tutti". Singapore sostiene e contribuisce all'azione multilaterale, ogni anno partecipa infatti agli accordi internazionali della *COP* sotto l'egida delle Nazioni Unite. Questo enfatizza sicuramente il suo impegno verso la sostenibilità a livello globale. Il suo coinvolgimento a riguardo sarà quindi analizzato nell'ultimo capitolo del presente elaborato, tenendo in considerazione aspetti importanti quali l'energia, il trasporto pubblico, il carbone, l'acqua, e i possibili limiti e opportunità nel processo verso la sostenibilità, in una prospettiva futura che mira all'azione contro i cambiamenti climatici nel rispetto degli obiettivi di sviluppo sostenibile entro il 2030.

INTRODUCTION

The present work aims at answering a very specific question, namely whether the design, the development and the creation of green eco-friendly cities is a way to contrast the major challenge we are facing nowadays, climate change. In this dissertation, the term “Green City” will mostly refer to this potential means available to us in order to oppose adverse climate phenomena, cause of early deaths, migration, economic and financial decline and social inequality. The goal of this thesis is therefore to try to give an answer and a contribution, amongst others, to the issue of climate change and the adverse effects thereof.

As it will be clearly explained later on, climate change is considered as a long-term change in the average temperatures and weather patterns on Earth.¹ Moreover, it is a threat multiplier, or a stress multiplier, meaning that it represents one of the most relevant challenges the humanity is facing today. It can be the driver and the multiplier of violent internal conflicts, since it leads to resource scarcity, thus, to disputes.²

Starting from the first chapter, several elements will be taken into consideration. In particular, a detailed connection between cities and climate change will be further analysed. Indeed, cities are the place where we all spend most of our time, where infrastructure, technology, business and industry develop; it is therefore an imperative to make them as green and liveable as possible in order to address climate issues.³ Thanks to the support of the National Aeronautics and Space Administration (NASA), the United States Environmental Protection Agency (EPA), the United Nations Climate Change

¹ NASA Global Climate Change. (2021, April 15). Overview: Weather, Global Warming and Climate Change, *NASA Global Climate Change*. Retrieved from: <https://climate.nasa.gov/resources/global-warming-vs-climate-change/>

² Huntjens, P. & Nachbar, K. (2015). Climate Change as a Threat Multiplier for Human Disaster and Conflict, *The Hague Institute Working Paper Series*, Working paper 9, pp. 3-4

³ United Nations Climate Change (UNCC): e-Learn. Transformative role of cities, In *Cities and Climate Change*, online course. Adapted from United Nations Human Settlements Programme (UN-Habitat), *State of the World's Cities 2012/2013*. Retrieved from: <https://uncclearn.org/course/view.php?id=21&page=course>. See also Alusi, A., Eccles, R. G., Edmondson, A. C. & Zuzul, T. (2011, March 20). *Sustainable Cities: Oxymoron or the Shape of the Future?* *Harvard Business School*, p. 2

(UNCC) e-learning partnership, several European bodies and reports' studies and websites, including the Intergovernmental Panel on Climate Change (IPCC), the research starts with the description of basic climate change problems, which have been hardly debated during the previous years and which are constantly debated through conferences and meetings, such as the latest G20 and COP26 meetings. The speeding up of global warming has recently revealed an insufficiency of international efforts to reverse these trends. Multilateral approaches as the 1992 United Nations Framework Convention on Climate Change (UNFCCC) that took place in Rio de Janeiro, the 1997 Kyoto Protocol, the 2001 Doha Climate Gateway, the 2012 Rio +20, and the 2015 Paris Agreement have been important in fostering an ever-growing sense of urgency and seriousness of the problem, but this has not been enough; despite important attainments and technological innovations, a solution has not been found yet. From the point of view of this dissertation, the problem lays in the governance system. States remain of basic importance in opposing climate change, since they retain a lot of powers in their hands; the European Union, a major supra-national entity, is dependent on its member-states' decisions, for example. Nevertheless, the state is divided into different layers, including regional, city and local government. That is to say that a multi-level and multi-actor system of governance is needed in order to fight climate change. Indeed, if there is not the support from the large industrial companies, the trade unions, the main organisations of civil society, and so forth, even the role of nation-states is limited. A. Giddens explains that states must work closely with a variety of local agencies and bodies, as well as with other countries, in order to be effective.⁴ Hence, cities' commitment towards climate change reveals fundamental in order to tackle climate change at local level. According to the C40 Cities Climate Change Leadership, cities represent the key to address global change.⁵ The analysis continues with the description of the interrelation between climate change and social inequality, also through a legal lens. Climate change, economic development and social inequality are intimately linked. Indeed, climate change exacerbates the social and economic precarity of poorer populations and communities. According to Singer, climate change can be considered a paradigmatic example of environmental injustice.⁶ This

⁴ Giddens, A. (2011). *The Politics of Climate Change*, Cambridge: Polity Press, II Ed., pp. 18-19

⁵ See C40 Cities. Retrieved from: <https://www.c40.org>

⁶ Singer, M. (2018). *Climate Change and Social Inequality: The Health and Social Costs of Global Warming*, London and New York: Routledge, I Ed., p. 29

means that even if poor people are not influential in the decisions and consequent actions that lead to anthropogenic climate warming, they pay the higher price for rising temperatures. The chapter will further take into account important aspects, such as how climate change affects urban living nowadays, also concerning the heat-health nexus between climate change and health risks in cities.⁷ Finally, it has been interesting to introduce the newest concept of “connectography”. Cities are ever expanding due to urbanisation processes, they can even be called megacities or megalopolis. Cities are the places where people can connect, thanks to globalisation and its means, namely transportation services, communication networks, technology, etc. According to the inventor of this term, Parag Khanna, “connectography” is the new paradigm through which we should face problems, indeed, people are ever more connected thanks to the mobility of people, goods and services, knowledge and information; thus, we should be more willing to address important problems together, such as climate change, social inequality, and wars, for example.⁸

The second chapter will focus on the concept of green and sustainable city, its evolution over time and its implications. The term “green” is used to refer to a variety of concepts, such as the need to protect our ecosystem from environmental risks that surround us or as resource efficiency, for example.⁹ “Green” acquires a broad meaning, which varies from the environmental level, such as waste management and recycling, the use of energy, the construction of sustainable buildings and infrastructure, the management of natural resources, to the business level.¹⁰ According to the scholars Harvey and Pow, green cities are the places whose purpose is to achieve a “win-win situation, manageable futures and prosperous development with rather than against nature”.¹¹ The indirect goal of this dissertation is also to create a connection between people and cities, because

⁷ Breil, M., Ellena, M. & Soriani, S. (2020, July 22). The heat-health nexus in the urban context: A systematic literature review exploring the socio-economic vulnerabilities and built environment characteristics, In *Urban Climate*, Elsevier, 34, pp. 14-15

⁸ Khanna, P. (2016). *Connectography: mapping the future of global civilisation*, New York: Random House, pp. 5-8, 383-384

⁹ Carley, S., Lawrence, S. (2011). Energy-based Economic Development, In *Renewable and Sustainable Energy Reviews*, Elsevier, 15:1, pp. 292-295

¹⁰ Ibid

¹¹ Harvey, N., Pow, C. P. (2015). Eco-cities and the Promise of Socio-Environmental Justice, *The International Handbook of Political Ecology*, Edited by Raymond L. Bryant, pp. 401-414

environmental design has precisely the aim of creating better living conditions for the population, as well as contributing to the reduction of carbon dioxide (CO₂) emissions. Therefore, the key to design efficiently a green city is also to create a linkage between humans and nature. Consequently, it has been fundamental to describe the green city's development criteria, namely security for the population, pollution prevention, infrastructure system, resource efficiency, sustainable urbanism, and technology (referring to the smart city). The ideal green city has the following characteristics: resource efficiency, renewable resources usage, an efficient transportation system, restoration of damaged urban areas, improvement of job and housing opportunities for all, social inclusion, promotion of local and sustainable agriculture.¹² Indeed, according to the scholar S. Campbell, sustainability is a very complex context which comprehends a variety of concepts. It has three pillars, namely economic development, environmental protection, and social justice.¹³ Some authors also focus on a fourth pillar, sustainable governance.¹⁴ Nevertheless, there are also some drawbacks related to the concept of sustainability, in this case the researcher V. Saiu has identified three limits a green city can have, namely the idea of the city as a business, the oversimplification of urban complexity, and the quest for the ideal community.¹⁵ These concepts will be further analysed in the chapter. As a consequence of this, in order to achieve sustainability in cities and to set emission reduction goals, cities must commit together. According to the UNCC e-learning partnership, different actors, groups and meetings have been created and organised at the local level, such as the Non-State Actor Zone for Climate Action (NAZCA), the Sustainable Cities Programme (SCP), the Global Cities Covenant on Climate, the Compact of Mayors, etc.¹⁶ At the beginning of the 21st century, the need to

¹² Sarkar, A. N. (2016). Eco-innovations in Designing Eco-cities and Eco-towns, *The Smart City Journal*. Retrieved from: <https://www.thesmartcityjournal.com/en/articles/1042-eco-innovations-eco-cities-eco-towns>

¹³ Campbell, S. (1996). Green Cities, Growing Cities, Just Cities? Urban Planning and the Contradictions of Sustainable Development, *Journal of the American Planning Association*, 62:3, p. 298

¹⁴ Blewitt, J. (2018). *Understanding Sustainable Development*, London and New York: Routledge, III Ed., pp. 151-153

¹⁵ Saiu, V. (2017, December 15). The Three Pitfalls of Sustainable City: A Conceptual Framework for Evaluating the Theory-Practice Gap, in Sustainability, *MDPI*, 2311:9, p. 4

¹⁶ United Nations Climate Change (UNCC): e-Learn. Commitments by cities and local governments on climate change, In Cities and Climate Change, online course. Retrieved from:

build ecological cities became more and more an inevitable reality. International conferences and multilateral climate agreements are increasingly focusing on the role of cities in combating global warming and the consequent environmental risks. At the end of the chapter, the Asian example concerning greenery is described. Indeed, today, Asia can be an example to follow regarding the exponential growth and development of eco-sustainable cities. The reason is very simple: in addition to being a generally technologically advanced continent, the rapid urbanisation process of the 21st century and the resulting rising standard of living drove some Asian cities to become important examples of green growth, firstly by adopting energy-efficient solutions to minimise the use of primary energy. In addition, according to Khanna, Asia is in the process of becoming a global superpower. Geographically speaking, as it is the largest continent in the world, and in economic and political terms, because the Asian Economic Zone represents respectively 50% of world Gross Domestic Product (GDP) and two-thirds of global economic growth.¹⁷ The implementation of sustainable policies within cities requires greater efforts, as governments need to reform institutions and strengthen energy and climate governance capacities and plans, but some Asian cities have not stopped in the face of this problem, trying to make the most of their potential.

The third chapter aims at introducing the case study of this thesis, namely Singapore city-state. The Singaporean example is a prototype of green transformation to follow; indeed, the city-state has the primacy for what concerns greenery, not surprisingly, it is called the “Garden City”. First of all, the reason why Singapore has been selected as the case study of this work lays in its sustainable and smart governance as a city-state. Secondly, it is an example to follow for neighbouring and beyond-the-region cities and countries, because it had to develop in a smart and green way in order to survive global shocks. Thus, it was able to transform its vulnerabilities and limits into a strength. Prime ministers’ technocratic perseverance, along with dynamism and innovative spirit, from Lee Kuan Yew to Goh Chok Tong to current Head of Government Lee Hsien Loong,

<https://uncclearn.org/course/view.php?id=21&page=course>. See also United Nations Climate Change (UNCC): e-Learn. The Compact of Mayors, In Cities and Climate Change, online course. Retrieved from: <https://uncclearn.org/course/view.php?id=21&page=course>. See also Global Covenant of Mayors. Retrieved from: <https://www.globalcovenantofmayors.org>

¹⁷ Khanna, P. (2019). *Il secolo Asiatico?* Roma: Fazi Editore srl, I Ed., traduzione di Thomas Fazi, pp. 11-

brought the city-state to success. The chapter will go deep into detail about Singapore's short but significant history, from colonialism to independence to Asia's greenest city-state. In 2021, according to Resonance Consultancy analysis, Singapore has been ranked the 8th greenest city in the world.¹⁸ While, according to the Asian Green City Index, Singapore was ranked as number one on average in the overall results in 2011.¹⁹ Singapore has a leadership in sustainability; the former Minister of the Environment Lim Swee Say once stated: "...We look ahead, plan for the future, set clear targets, and pursue the necessary policies head on with clear thinking and concrete strategies...".²⁰ On February 10, 2021, Singapore adopted its Green Plan 2030, which aims to strengthen Singapore's commitment under the United Nations' 2030 Sustainable Development Agenda and Paris Agreement, with the final goal of achieving net-zero emissions as soon as possible.²¹ Green buildings represent a fundamental mitigation strategy for the city-state, indeed, the chapter will focus on two important green buildings, namely Nanyang Technological University Singapore and Khoo Tech Puat Hospital. Singapore's expertise has made this city a global centre for the export of knowledge and talent, becoming a model for the world, especially for its neighbouring China. In fact, the collaboration project between China and Singapore has been shown in the creation of the "ecological city" of Tianjin, in China.²² Therefore, this project will be analysed in the chapter to raise awareness about the Chinese interest towards the Singaporean model.

The fourth and last chapter will consider Singapore's Climate Action Plan 2016, its most recent climate plan, if not the most innovative. Singapore's commitment towards climate

¹⁸ Fair, C. (2020, April 22). The World's Greenest Cities are our future, In Best Cities, *Resonance*. Retrieved from: <https://www.bestcities.org/news/2020/04/22/the-worlds-greenest-cities/>

¹⁹ The Asian Green City Index measures the environmental performance of 22 Asian capital cities. Economist Intelligence Unit. (2011). *Asian Green City Index*, Munich, Germany: Siemens AG, pp. 10-11

²⁰ Media Relations Division, Ministry of Information, Communications and the Arts. Discourse by the Minister of the Environment Lee Swee Say at the launch of the Singapore Green Plan 2012, 10.00 am, August 24, 2002, Sheraton Towers. Retrieved from: <https://www.nas.gov.sg/archivesonline/data/pdfdoc/2002082405.htm>

²¹ Singapore Government Website. Singapore Green Plan 2030. Retrieved from: <https://www.greenplan.gov.sg/key-focus-areas/overview>. See also <https://www.youtube.com/watch?v=oNFeOI7pW9s>

²² Curien, R. (2017). Singapore, a Model for (Sustainable?) Urban Development in China. An Overview of 20 years of Sino-Singaporean Cooperation, *China Perspectives*, 1, p. 30

change starts with this plan, which aims at reducing CO₂ emissions by 36% below 2005 levels by 2030, enhancing efficiency in every sector, namely the industrial, building, transportation, household, water and waste ones.²³ In addition, the Climate Action Plan aimed at drafting Singapore's first Nationally Determined Contributions (NDCs). Even if Singapore is a small island-state and its emissions are not very impacting at global level (it accounts for only 0.2% of global CO₂ emissions), it aims at achieving a green transition. In support of this thesis, Singapore outlined its low-emissions development strategy (LEDS) in the document entitled "Charting Singapore's Low Carbon and Climate Resilient Future".²⁴ Singapore designed its LEDS on three key pillars: to transform the economy, industry and society, to use innovative technologies, and to build international partnerships. More specifically, regarding the first pillar, energy efficiency, resource conservation, and innovation are the drivers of the new transformation towards a greener economy. Concerning the second pillar, Singapore is investing in Research and Development (R&D) in order to develop new mechanisms for energy and carbon management; this involves under-study innovative technologies. For what concerns the third pillar, in order to support environmental restoration, more international effort is needed, and Singapore is part of the international community; thus, it is striving for achieving this objective, namely Goal 17 of the Sustainable Development Goals (SDGs) 2030.²⁵ Singapore's commitment regarding its most important sectors will be deeply analysed, as well as problems and opportunities in the process towards sustainability, such as water scarcity and water quality, land challenge, and biodiversity and quality of living.

²³ Strategy Group Prime Minister's Office, National Climate Change Secretariat. (2016). *Singapore's Climate Action Plan. Take Action Today, for a Carbon-Efficient Singapore*, Singapore: Strategy Group Prime Minister's Office, National Climate Change Secretariat, p. 2

²⁴ Strategy Group Prime Minister's Office, National Climate Change Secretariat. (2020). *Charting Singapore's Low Carbon and Climate Resilient Future*, Singapore: Strategy Group Prime Minister's Office, National Climate Change Secretariat, p. 1

²⁵ Ivi, p. 7

CHAPTER I

Cities and climate change

According to NASA's Global Climate Change Website, climate change is defined as: "A long-term change in the average weather patterns that have come to define Earth's local, regional and global climates. These changes have a broad range of observed effects that are synonymous with the term".²⁶ A vast number of changes that we are observing, from the 20th century until now, are mainly led by human activities, as it will be explained in more detail along the chapter. Fossil fuel burning is included in the list of human activities that are damaging our atmosphere, followed by an increase in Earth's surface temperature, but also by an augmentation of pollution levels, such as smog and acid rains.²⁷ Natural activities can also contribute to climate change patterns, such as forecasts variability (rain periods, drought periods, storms...) and changes in the Sun's energy, to name a few. The increase in temperatures due to human activities is referred as to global warming. Indeed, global warming is the heating up of Earth's climate due to human-produced actions; it is measured from the pre-industrial period in order to compare the different levels of growth of heat waves. Indeed, since 1900s ca, Earth's temperature has increased by about 1°C, but unfortunately this number is currently growing decade after decade.²⁸

It has been estimated that the years 2016 and 2020 have been the warmest on record, while, from the beginning of the 21st century, the trend has never stopped to increase (figure 1).²⁹

²⁶ NASA Global Climate Change. (2021, April 15). Overview: Weather, Global Warming and Climate Change, op. cit.

²⁷ US Environmental Protection Agency (EPA). (2019, February 4). The Sources and Solutions: Fossil Fuels, In Nutrient Pollution, *US Environmental Protection Agency (EPA)*. Retrieved from: <https://www.epa.gov/nutrientpollution/sources-and-solutions-fossil-fuels>

²⁸ NASA Global Climate Change. (2021, April 15). Overview: Weather, Global Warming and Climate Change, op. cit.

²⁹ NASA Goddard Institute for Space Studies. Global Annual Mean Surface Air Temperature Change, Credit: NASA/JPL-Caltech. Retrieved from: https://data.giss.nasa.gov/gistemp/graphs_v4/

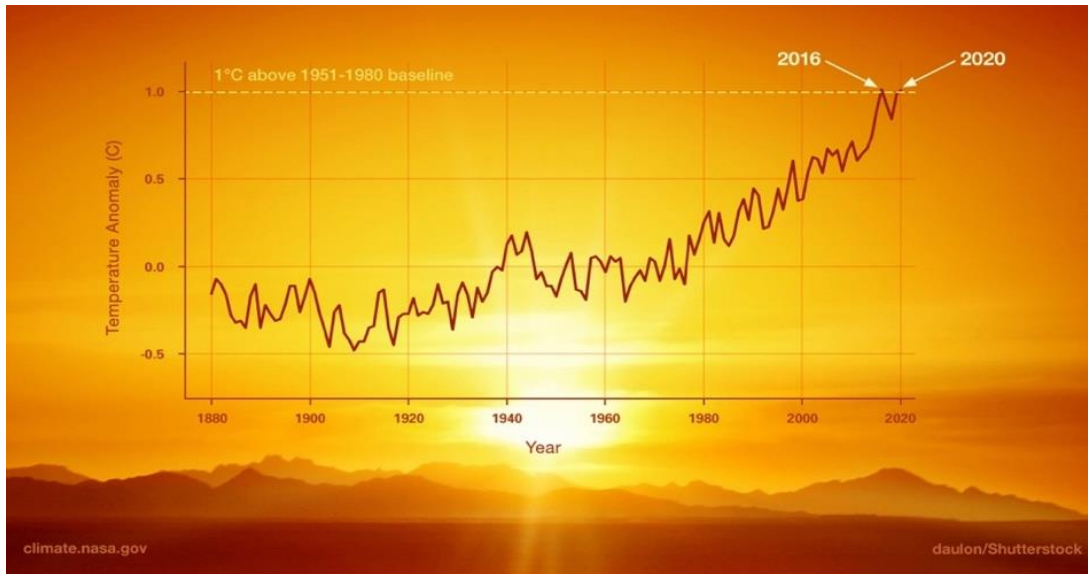


Figure 1. Global warming trends relative to 1950-1980 average temperatures, with 2016 and 2020 as the warmest years

This chapter aims to present an overview of the link between cities and climate change. First of all, it has been necessary to develop a brief introduction about basic climate change concerns in order to present the major problems related to it and the subsequent collaborative efforts done so far in order to cope with this fragile situation, such as the Kyoto Protocol of 1997 or the Paris Agreement of 2015. Secondly, a discourse about climate change and social inequality related problems has been opened. Today, inequality dynamics from the geographical point of view are less and less related with the geographical division between nation-states. Climate change exacerbates environmental injustice: rich people (especially in advanced nations but also in emerging ones) become richer and pollute, because of their production and consumption habits, while poor people (especially in emerging countries but also in advanced ones) bear the costs. Furthermore, a legal ground has been considered in order to debate about how efficient the law is on this topic. Thirdly, the correlation between cities and climate change has been analysed. Urbanisation is one of the most evident causes of global warming, because human industrial activities are concentrated in urban zones, hence cities result in bubbles soaked with heat waves. Finally, a new innovative concept has been introduced: “connectography”. The global strategist P. Khanna has fused on two concepts together, which, according to him, cannot stand alone: geography and connectivity. Our contemporary world is made of interconnectedness between people, and megalopolis are the operational base for this connection.

These concepts will be discussed in detail in the following pages.

1.1 Basic climate change concerns

One of the biggest challenges for humanity over the coming centuries is climate change. A vast number of experts have reported scientific evidence that the Earth is overheating and humans contribute constantly to its warming. According to Wenhong Li, an atmospheric scientist, global warming abruptly affects local weather in different parts of the world, sometimes causing disastrous effects. Indeed, in 2007 the state of Georgia suffered from severe droughts caused by variations in the precipitation standards in the southeastern United States.³⁰ Climate variations are impacting severely our ecosystem and they are producing adverse consequences on human health and way of living.

The speeding up of climate change in the last twenty years, due to the increase of greenhouse gases (GHG), demonstrates the insufficiency of international efforts in order to reverse these trends. There have been some multilateral approaches in order to cope with this situation, such as the 1992 UNFCCC, signed by 154 states at the Earth Summit in Rio de Janeiro and ratified in 1994; the 1997 Kyoto Protocol, the third Conference of the Parties³¹ (COP3), ratified in 2005, followed by annual COP meetings³²; the Doha Climate Gateway of 2001; the 2012 Rio +20; the 2015 Paris Agreement, to mention but a few. They fostered a growing sense of urgency, settling a combination of two different efforts in order to act against climate change: mitigation (reducing GHG emissions) and adaptation (coping with the impacts of global warming).³³

Not acting on climate change will hamper the effectiveness of other development policies, such as education, health and poverty. For example, climate change can lead to

³⁰ Singer, M. (2018). *Climate Change and Social Inequality: The Health and Social Costs of Global Warming*, op. cit., pp. 9-10

³¹ The Conference of the Parties is the supreme decision-making body of the UNFCCC. All the Parties to the Convention are represented by the COP, at which they review the effective implementation of the Convention. The COP meets every year, unless the Parties decide otherwise. The first COP meeting was held in 1995 in Berlin, Germany, while the last COP meeting so far will be held from 29 October to 12 November 2021 in Glasgow, Scotland. The COP meets in Bonn, the seat of the Secretariat, unless a Party decides to host the meeting by its own.

³² United Nations Climate Change (UNCC) Website. Conference of the Parties, in Bodies, *United Nations Climate Change*. Retrieved from: <https://unfccc.int/process/bodies/supreme-bodies/conference-of-the-parties-cop>

³³ Huntjens, P. & Nachbar, K. (2015). Climate Change as a Threat Multiplier for Human Disaster and Conflict, op. cit., p. 1

detrimental health effects in slums, loss of property and possessions; thus, it can lead to more poverty. On the other hand, climate change adaptation and mitigation can lead to benefits in other policy areas, for instance, climate change mitigation in the form of improvement in public transport in a city can both reduce GHG emissions and improve equality. Similarly, investing in renewable energy is one of climate change mitigation measures that can lead to the creation of new jobs. Building roads that better withstand the effects of climate change is an example of an adaptation measure that can stimulate economic growth.³⁴

The international efforts to reduce emissions, in particular CO₂ ones, should stabilise climate change at least, keeping it from worsening.

Climate change is linked to climate security, because it is a threat to human safety and many countries have identified it as a national security challenge, such as the United States, India, Germany and the United Kingdom.³⁵ Indeed, for nation-states, climate change is threatening their state functions, for example, institutional functions, sovereignty, territorial integrity, etc. It is a threat multiplier, in the sense that it can be a driver of violent conflicts (in a realist perspective, climate change can induce competition of states over new resources, maybe real conflicts), because it leads to resource scarcity, like water and arable lands, and thus to disputes.³⁶ Indeed, for example, in many countries of Middle East-North Africa (MENA) region, water is an essential resource considered a national security concern.³⁷

Moreover, another consequence of climate change is migration. Since many people in search for improved conditions are displaced and will be displaced by climate change, mass migration has been regarded as a security risk of global warming.³⁸ The IPCC, in its first assessment report of 1990, stated: “The gravest effects of climate change may be

³⁴ United Nations Climate Change (UNCC): e-Learn. The possible consequences of action and inaction on climate change, In Cities and Climate Change, online course. Retrieved from: <https://uncclearn.org/course/view.php?id=21&page=course>

³⁵ Huntjens, P. & Nachbar, K. (2015). Climate Change as a Threat Multiplier for Human Disaster and Conflict, op. cit., p. 2

³⁶ Ivi, pp. 3-4

³⁷ De Châtel, F. (2014, January 27). The Role of Drought and Climate Change in the Syrian Uprisings: Untangling the Triggers of the Revolution, In Middle Eastern Studies, *Routledge*, 50:4, p. 528

³⁸ Brzoska, M. & Fröhlich, C. (2015, March 30). Climate change, migration and violent conflict: vulnerabilities, pathways and adaptation strategies, In Migration and Development, *Routledge*, 5:2, p. 191

those on human migration as millions are displaced by shoreline erosion, coastal flooding and severe drought”.³⁹ Furthermore, in 2008 the European Commission and the European Union High Representative for the Common Foreign and Security Policy wrote a report, which stressed: “Europe must expect substantially increased migratory pressure”.⁴⁰ Thus, one of the causes of migratory flows in Europe is climate change.

Yet, other effects of climate change are serious diseases, extreme weather, rising sea-level, the critical state of coral reefs, urban heating, unsuitable crops, but also cultural heritages sites being ruined by its adverse effects, for example.⁴¹

The Human Development Report (HDR) of the United Nations Development Programme (UNDP) of 1994 claimed that we, as humans, need to reconceptualise security in terms of human rather than territorial or state, so looking at security from a human lens. It directly reported: “We need another profound transition in thinking from nuclear security to human security”.⁴² Hence, the respect of human rights is fundamental. Adaptation efforts should be designed and implemented in a tailored manner, considering the social context, because otherwise they could threaten human security. Studies made by Patrick Huntjens and other scholars on Nobel Prize Winner Elinor Ostrom⁴³ have demonstrated that we need to consider some arrangements and recommendations in order

³⁹ Intergovernmental Panel on Climate Change (IPCC). (1990). First assessment report, Working group II, Geneva. Retrieved from:

https://www.ipcc.ch/site/assets/uploads/2018/03/ipcc_far_wg_II_full_report.pdf

⁴⁰ Council of the European Union. (2008, March 3). Climate change and international security, Report 7249/08, Brussels. Retrieved from:

<https://data.consilium.europa.eu/doc/document/ST%207249%202008%20INIT/EN/pdf>

⁴¹ Singer, M. (2018). *Climate Change and Social Inequality: The Health and Social Costs of Global Warming*, op. cit., pp. 11-24

⁴² United Nations Development Programme (UNDP). (1994). Human Development Report 1994, New York: Oxford University Press, p. 22. Retrieved from:

http://www.hdr.undp.org/sites/default/files/reports/255/hdr_1994_en_complete_nostats.pdf

⁴³ Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*, New York: Cambridge University Press; see also (2007, September 25). A Diagnostic Approach for Going Beyond Panaceas, Proceedings of the National Academy of Sciences, *PNAS*, 104:39, pp. 11581-11587

to overcome this big problem, such as clearly defined boundaries, opportunity costs analysis, sanctions, implementation of conflict prevention and resolution processes.⁴⁴

The Yale University Project on Climate Communication conducted a research in 2010, called “Global Warming’s Six Americas”, which revealed that almost half of all Americans said that they lacked information in order to generate a firm opinion regarding global warming.⁴⁵ Thus, more cooperation and transparency between countries at the global scale is needed in order to avoid a climate disaster.

A survey conducted by the Eurobarometer of the European Commission from March 2021 to April 2021 revealed that European citizens believe that environmental change is the most serious problem the world is facing. Nine people out of ten interviewed consider climate change as a serious problem (93%), and almost eight people out of ten assume it to be very serious. The majority of European citizens (64%) is already acting individually in order to fight climate change, and it is adopting sustainable lifestyles. It is very clear that the fight against global warming reserves important opportunities for European citizens and for the economy. Indeed, almost eight European citizens out of ten (78%) agree on the fact that climate action will result in innovations, which will increase European enterprises’ competition.⁴⁶

Overall, global awareness is important. On September 2020, two American artists, namely Gan Golan and Andrew Boyd, installed a “Climate Clock” in front of a building in Union Square, Manhattan, as a sort of artistic awareness. This clock announces how much time still we have before humanity encounters an irreversible climate emergency. According to some scientists, we still have about 7 years until Earth’s CO₂ standard is

⁴⁴ Huntjens, P., Lebel, L., Pahl-Wostl, C., Camkin, J., Schulze, R. & Kranz, N. (2012). Institutional design propositions for the governance of adaptation to climate change in the water sector, In *Global Environmental Change, Elsevier*, 22:1, pp. 67-81

⁴⁵ Leiserowitz, A., Maibach, E., Roser-Renouf, C. & Smith, N. (2010), *Global Warming’s Six Americas, Yale Project on Climate Change*, New Haven: Yale University and George Mason University, p. 11. Retrieved from: <https://climatecommunication.yale.edu/wp-content/uploads/2016/02/2010-June-Six-Americas.pdf>

⁴⁶ Eurobarometer. (2021, from March to April). Climate change. Retrieved from: <https://europa.eu/eurobarometer/surveys/detail/2273>

depleted.⁴⁷ This countdown must keep new generations' attention, which can make the difference in the future.

1.2 Climate change and social inequality

Scholars C. Wright and D. Nyberg affirmed: “Business and other market entities ... have a voice and enjoy the biggest say; others, such as local communities and [those] with limited political impact, have no voice, yet are left to face the greatest uncertainties”.⁴⁸ In a political-ecological perspective, environmental crisis must be analysed within the whole economic, social and political context. That is to say that vulnerability and risks induced by climate change are produced in and by society. Thus, the environmental discourse is linked to social structures and dynamics, meaning that it has different local implications.⁴⁹

An important capitalistic centric point refers to the fact that the major transnational companies play a fundamental role in producing climate risks. The fact is that we are not all responsible at the same level, some actors are more responsible than others. The few are responsible and the many are affected, but we have to acknowledge where the few are located and where the many are located.⁵⁰

1.2.1 The big polluters and underdeveloped societies

In the World Summit for Social Development (WSSD) of 1995, it was claimed: “In countries throughout the world, the expansion of prosperity for some [has been]

⁴⁷ Moynihan, C. (2020, September 20). A New York Clock That Told Time Now Tells the Time Remaining, *The New York Times*. Retrieved from: <https://www.nytimes.com/2020/09/20/arts/design/climate-clock-metronome-nyc.html>

⁴⁸ Wright, C. & Nyberg, D. (2015). *Climate Change, Capitalism, and Corporations. Processes of Creative Self-Destruction*, Cambridge University Press, p. 67

⁴⁹ Singer, M. (2018). *Climate Change and Social Inequality: The Health and Social Costs of Global Warming*, op. cit., pp. 25-30

⁵⁰ Ibid

accompanied by an expansion of unspeakable poverty for others”.⁵¹ Indeed, scholar Kenneth McGill affirmed: “We live in a world of extreme inequality”.⁵²

Development has been identified with the advancement of the Western world, while leaving the non-Western one marginalised.⁵³

Actually, developed nations tried to help less developed ones through providing development loans and grants. Indeed, Western developed countries created different institutions, such as the International Monetary Fund (IMF), the World Bank and the World Trade Organisation (WTO), amongst others, in order to promote development. Nevertheless, the disparity between wealthy and poor societies came to a head in the Debt Crisis that happened during the decade between 1970s and 1980s. In that period, many poor countries could not afford to repay their debts to rich countries, in particular to their institutions.⁵⁴

Another important point concerns the polluting elites, referring to the industrial capitalist class; thus, corporations are considered one of the main drivers of pollution. Lynch et al. affirmed: “[Capitalism] promoted ecologically destructive behaviour by profit-driven corporations, exploits nature and human labour, generated ecological destruction/disorganisation, and furthers the unequal distribution of wealth and ecological resources”.⁵⁵ According to an analysis by the Centre for Public Integrity, taking into consideration some United States databases, the polluting elites are contaminating the environment and the atmosphere, creating health risks for the human lives. Moreover, amongst different places, this investigation discovered that air pollution is concentrated

⁵¹ World Summit for Social Development (WSSD). (1995, March 6-12). Copenhagen Declaration on Social Development (CDOSD), Part A, Art. 13, Copenhagen. Retrieved from:

<https://www.un.org/development/desa/dspd/world-summit-for-social-development-1995/wssd-1995-agreements/cdosd-part-a.html>

⁵² McGill, K. (2016). *Global Inequality*, Toronto: University of Toronto Press, p. 27

⁵³ Escobar, A. (2011). *Encountering Development: The Making and Unmaking of the Third World*, Princeton: Princeton University Press, p. 13

⁵⁴ Singer, M. (2018). *Climate Change and Social Inequality: The Health and Social Costs of Global Warming*, op. cit., p. 51

⁵⁵ Barrett, K. L., Long, M., A., Lynch, M. J. & Stretesky, P. B. (2017). Social Justice, environmental destruction, and the Trump presidency: A criminological perspective, *Social Justice: A Journal of Crime, Conflict, and World Order*, 44:1, p. 8

also in the United States, in particular in some industrial sites in southwest Indiana.⁵⁶ One of these super polluters is ExxonMobil's factory and petrochemical plant in Baytown, Texas and in Baton Rouge, Louisiana, the latter being responsible for serious health problems.⁵⁷ Another big polluter is James H. Miller Jr. Electric Generating Plant, based in north-central Alabama. As claimed by the United States EPA data, this industry has been one of the top three polluters in United States concerning GHG emissions since 2010, amongst other energy production activities.⁵⁸

On a large scale, the wealthiest population is the biggest GHG emitter. Oxfam International studied that the large majority of poor people, about 3.5 billion in the world, is responsible for only 10% of carbon emissions, while the wealthiest 10% of population in the world is responsible for half of global carbon emissions.⁵⁹ Furthermore, Oxfam International stated: "The poorest are often the most vulnerable and least prepared to cope with the effects of climate change, regardless of national borders."⁶⁰

The levels of emissions are influenced by different factors. In general, cities in the developing world have lower emissions than cities in the developed one, but there are clear data which highlight the fact that the rich in the developing cities produce higher emissions than the poor. Some of the factors which influence emissions levels are the demographic composition of a society, the location of a city, the different types of economic activities which take place in a city and the urban form; concerning the last

⁵⁶ Hopkins, J. (2016, September 29) Meet America's super polluters, *USA Today*. Retrieved from: <https://eu.usatoday.com/story/news/2016/09/29/toxic-air-pollution-concentrated-small-number-sites/90846584/>

⁵⁷ Singer, M. (2018). *Climate Change and Social Inequality: The Health and Social Costs of Global Warming*, op. cit., p. 54

⁵⁸ Hernandez, E. (2017, June 5). America's biggest greenhouse-gas polluter, and the place that relies on it, *The Centre for Public Integrity*. Retrieved from: <https://publicintegrity.org/environment/americas-biggest-greenhouse-gas-polluter-and-the-place-that-relies-on-it/>

⁵⁹ Oxfam International. (2015, December 2). World's richest 10% produce half of carbon emissions while poorest 3.5 billion account for just a tenth, *Oxfam International*. Retrieved from: <https://www.oxfam.org/en/press-releases/worlds-richest-10-produce-half-carbon-emissions-while-poorest-35-billion-account>

⁶⁰ Ibid

factor, for example, more dense cities are more willing to put in place public transport systems, so the level of emissions may be lower than a less compact urban area.⁶¹

Having said that, the growing disparity between the wealthiest and the poorest is to be considered with qualm, being climate change and inequality a persistent concern.

1.2.2 Legal concerns

There have been several debates about the right punishment to give to the big polluters. Until 2016, it was not clear if environmental crimes could be intended as crimes against humanity. In 2016, the International Criminal Court (ICC) recognised pollution and exploitation of the environment as a priority to consider. According to the Centre for Climate Crime Analysis (CCCA), a non-profit organisation which supports climate justice at both the national and international level, environmental crimes may menace international peace and security and may be a threat to human health.⁶² In 2018, CCCA and Europol signed a Memorandum of Understanding (MoU) in order to jointly assess their efforts in the challenge towards climate crimes. The MoU is therefore a framework for cooperation between the two organisations.⁶³

Climate crime is recognised as an EMPACT⁶⁴ priority, a European Union four-year policy interested in fighting international crimes. According to Europol, environmental crimes can include:

Improper collection, transport, recovery or disposal of waste; illegal operation of a plant in which a dangerous activity is carried out or in which dangerous substances or preparations are stored; killing, destruction, possession or trade

⁶¹ United Nations Climate Change (UNCC): e-Learn. Factors influencing emissions in cities, In Cities and Climate Change, online course. Adapted from United Nations Human Settlements Programme (UN-Habitat) Global Report on Human settlements, 2011: Cities and Climate Change. Retrieved from: <https://uncclearn.org/course/view.php?id=21&page=course>

⁶² Centre for Climate Crime Analysis (CCCA). Prosecuting climate crimes as a matter of priority and general deterrence, CCCA. Retrieved from: <http://www.climatecrimeanalysis.org/priority-prosecution.html>

⁶³ Europol. (2018, May 4). Europol and the Centre for Climate Crime Analysis together against criminal activities related to air pollution and deforestation, *Press Release*. Retrieved from: <https://www.europol.europa.eu/newsroom/news/europol-and-centre-for-climate-crime-analysis-together-against-criminal-activities-related-to-air-pollution-and-deforestation>

⁶⁴ European Multidisciplinary Cooperation Platform Against Criminal Threats

of protected wild animal or plant species; production, importation, exportation, marketing or use of ozone-depleting substances.⁶⁵

Environmental crime presents a number of heavy consequences which have a severe impact on our natural habitat. Indeed, our ecological equilibrium may be affected. Moreover, if this type of criminal activity is not properly supervised, the level of pollution and of degradation of our ecosystem will increase. The risks are therefore very high, including the possibility of an increase in serious human diseases, increasing environmental disasters, irreversible consequences on climate stability and on human health.

As previously stated, climate crime has been recognised as an ICC priority a few years ago. For this reason, sanctions are not enough, and traffickers and crime groups take advantage of this situation. In this context, the definition of eco-inequity arises, as mentioned by Singer, meaning that the polluting elites operate producing GHG, in particular CO₂, undermining poorest people which have to suffer the harmful consequences of big polluters' activity. Singer points out that there is the necessity of an eco-equity in order to achieve our environmental goals, in particular net-zero emissions and a global temperature rise below 2°C.⁶⁶

Hence, even though it is not legally recognised in international treaties, there is an obvious connection between environmental law and human rights. Several cases have been considered, one of them is the famous case of *Urgenda v. the State of the Netherlands*.⁶⁷ This has been the most debated case in Europe. Indeed, the applicants, the non-governmental organisation (NGO) Urgenda Foundation (from Urgent Agenda) and 900 Dutch citizens, urged Dutch government for limiting GHG emissions of 25 percent in 2020 compared to emissions level of 1990.⁶⁸ The Hague Court of Appeal argued that the state has obligations in order to protect the right to a healthy environment, referring to Article 2 (Right to life) and Article 8 (Right to respect for private and family life) of

⁶⁵ Europol. Environmental Crime, In Crime Areas, *Europol*. Retrieved from:

<https://www.europol.europa.eu/crime-areas-and-trends/crime-areas/environmental-crime>

⁶⁶ Singer, M. (2018). *Climate Change and Social Inequality: The Health and Social Costs of Global Warming*, op. cit., p. 59

⁶⁷ Baldin, S. & De Vido, S. (2020). *Environmental Sustainability in the European Union: Socio-Legal Perspectives*, Trieste: Edizioni Università di Trieste (EUT), pp. 105-106

⁶⁸ *Ibid*

the European Convention on Human Rights (ECHR).⁶⁹ The Court finally concluded that the Dutch government was not meeting the requirements according to the ECHR, and that it violated Articles 2 and 8 of the ECHR.⁷⁰

Another central aspect to the point in question is the principle of “common but differentiated responsibilities” within the framework of UNFCCC.⁷¹ It acknowledges that states must cooperate to achieve a sustainable and green future, helping low-income countries in their fight towards the costs of mitigation and adaptation efforts. Nevertheless, there is a great controversy caused by the fact that states must contribute to climate change efforts, but, at the same time, their private corporations, the so-called big polluters as already discussed, are the ones who contribute the most to pollution with their own business.⁷²

Furthermore, according to the Inter-American Court of Human Rights, in its advisory opinion of November 2017, the right to a healthy environment is fundamental for the existence of humankind. The Court has recognised the relationship between the environment and human rights, in that environmental degradation can affect human rights severely, in particular the right to health.⁷³

In addition to different conventions and declarations, the right to a healthy environment has been referred to in two regional human rights bodies: the African Charter, established by the African Commission on Human and People’s Rights⁷⁴ and the Additional Protocol

⁶⁹ European Convention on Human Rights (ECHR), Art. 2/Art. 8, Section I. Retrieved from: https://www.echr.coe.int/documents/convention_eng.pdf

⁷⁰ Baldin, S. & De Vido, S. (2020). *Environmental Sustainability in the European Union: Socio-Legal Perspectives*, op. cit.

⁷¹ Climate Nexus. Common but differentiated responsibilities and respective capabilities (CBDR-RC), *Climate Nexus*. Retrieved from: <https://climatenexus.org/climate-change-news/common-but-differentiated-responsibilities-and-respective-capabilities-cbdr-rc/#mobile-site-navigation>

⁷² Ibid

⁷³ Inter-American Court of Human Rights. (2017, November 15). Advisory Opinion OC-23/17, p. 21. Retrieved from: <https://elaw.org/system/files/attachments/publicresource/English%20version%20of%20AdvOp%20OC-23.pdf>

⁷⁴ African Charter. (1986, October 21). Art. 24: Right to a General Satisfactory Environment. Retrieved from: <https://www.achpr.org/legalinstruments/detail?id=49>

to the American Convention of Human Rights.⁷⁵ Moreover, it has been recognised also by the Aarhus Convention, the United Nations Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters.⁷⁶ This Convention provides for the right to participate in environmental decision-making.⁷⁷

The right to a healthy environment has been recognised by at least one hundred countries in their constitutions and legislations, but this is not enough. Indeed, this right has not been globally identified as a duty yet.⁷⁸

1.3 How climate change affects urban living nowadays

Nowadays, direct and indirect impacts of climate change are affecting the urban population, in particular in less developed and developing countries. The level of devastation caused by climate change related consequences to urban dwellers, in particular to their health, to the economy, to the financial stability, etc. needs further attention. Worldwide, in particular in low- and middle-income countries, the effects of climate change have been manifest: storms, flooding, starvation due to destruction of crops, reduction in water supply, heat waves, economic defaults... The need of major changes in the government of urban areas is fundamental in order to tackle this situation. The reasons are basically three: a growing number of people at risk from environmental problems live in urban areas; the vast majority of low-income nations do not possess the right buildings and infrastructures in order to cope with the effects of climate change, so adaptation efforts are necessary; vulnerability to climate change is increasing in urban

⁷⁵ Additional Protocol to the American Convention of Human Rights in the area of Economic, Social and Cultural rights “Protocol of San Salvador”. (1988, November 17). Art. 11: The Right to a Healthy Environment. Retrieved from: https://www.ohchr.org/_layouts/15/WopiFrame.aspx?sourcedoc=/Documents/Issues/Environment/Mappingreport/13.Inter-American-26-March.doc&action=default&DefaultItemOpen=1

⁷⁶ Aarhus Convention. (1998, June 25). Retrieved from: <https://ec.europa.eu/environment/aarhus/>

⁷⁷ Ibid

⁷⁸ Baldin, S. & De Vido, S. (2020). *Environmental Sustainability in the European Union: Socio-Legal Perspectives*, op. cit., p. 110

areas.⁷⁹ There are particularly vulnerable groups, such as the elderly, children and women. According to the United Nations Human Settlements Programme (UN-Habitat) report of 2014, “Planning for Climate Change”, vulnerability is referred as being a function of exposure, sensitivity and adaptive capacity. Exposure analyses to what degree a city is exposed to changes in climate, including projected future changes. Sensitivity is the degree to which people, places, institutions and sectors are affected now and in the future by climate change. Finally, adaptive capacity refers to the degree to which people, places, institutions and sectors are able to adapt and become more resilient to impacts of global warming.⁸⁰ Effects of climate change are not the same for all cities. Indeed, exposure, sensitivity and adaptive capacity depend on the place considered. For example, regarding exposure, many of the world’s urban places are located in vulnerable areas, such as coastal areas, which are much more exposed to the severe impacts of climate change. Concerning sensitivity, the presence of unplanned urbanisation, which translates in slums and informal settlements, and the lack of adequate infrastructure, are affecting developing country cities, making them more vulnerable. Finally, adaptive capacity also depends on a series of things; indeed, developing country cities often have lower adaptive capacity than developed ones, because they do not have the same resources needed in order to adapt to climate change as developed country cities generally do.⁸¹

One example of affected region by climate change is Bangladesh, because it is both low-lying and densely populated. It is at risk of the main climate threats, such as drought, storms, floods, sea-level rise and agricultural devastation. At the same time, Dhaka’s GDP

⁷⁹ Lankao, R., Huq, S., Pelling, M., Reid, H. & Satterthwaite, D. (2007, October 1). Adapting to Climate Change in Urban Areas. The possibilities and constraints in low- and middle-income nations, *IIED Working Paper*, p. vii

⁸⁰ United Nations Climate Change (UNCC): e-Learn. Climate change vulnerability and adaptive capacity, In *Cities and Climate Change*, online course. Adapted from United Nations Human Settlements Programme (UN-Habitat). (2014). Planning for Climate Change. Retrieved from: <https://uncclearn.org/course/view.php?id=21&page=course>

⁸¹ United Nations Climate Change (UNCC): e-Learn. Effects of climate change are not the same for all cities, In *Cities and Climate Change*, online course. Adapted from United Nations Human Settlements Programme (UN-Habitat). (2011). *Cities and Climate Change: Global Report on Human Settlements 2011*. Retrieved from: <https://uncclearn.org/course/view.php?id=21&page=course>

per capita is the lowest of all megacities, and this disadvantage has an impact on the city's adaptation capacity.⁸²

The process of urbanisation started with the advent of the First Industrial Revolution (18th-19th century) which has substantially increased the number of people living in cities, someone being forced to leave its rural property for working reasons. A number of innovations have been created, from the economic, social and technological standpoint, but there are also a variety of disadvantages to consider, starting from the disparity between the First World and the Third World, which still present a wide developmental gap. In addition, the process of urbanisation is strongly linked to global warming, because the industrial activity is concentrated in the urban space. Furthermore, the ones who pollute more are the ones who live in best economic conditions, where the majority of CO₂ emissions take place.⁸³

At this time, only the 9% of cities around the globe have an average temperature beyond 38°C, but forecasts envisage that this number will increase more than two-fold by the year 2070.⁸⁴ Seasons will mutate, there will be peak temperatures, in addition to storms and flooding.

1.3.1 Urbanisation in the 21st century

As already pointed out, urbanisation started between the 18th and 19th century, first in Europe, where the Industrial Revolution took place, and then in the Americas. A great transformation from a rural society to an urban industrialised one occurred. This change is continuing and even growing in the developing world.

Today, more than 54% of the global population lives in cities (in 1950, the number amounted at 30%). Forecasts show that by 2050 more than 68% of people will live in

⁸² Ibid

⁸³ Ibid

⁸⁴ Nadotti, C. (2021, February, 19). Sempre più calde e meno umide: le città del futuro saranno bollenti, *La Repubblica*. Retrieved from: https://www.repubblica.it/greenandblue/2021/02/19/news/sempre_piu_calde_e_meno_umide_le_citta_del_futuro_saranno_bollenti-288019262/

urban spaces, with a growing quantity ranging around 2.5 billion until 2050. The 90% of the amount is concentrated in Asia and Africa.⁸⁵

Some studies highlight that there are some differences in urbanisation divisions between developed countries and less developed ones. The numbers regarding the first category are less important than that of the second one.

In 1950, developed countries were more urbanised than less developed ones, since a greater number of people lived in cities (446 million in developed regions compared to 305 million in underdeveloped regions). Starting from 1970, the curve began to diverge: the quantity of people living in urban spaces in less developed states surpassed that of developed states (680 million in underdeveloped regions compared to 674 million in developed regions). This difference continued to increase, and it is expected to grow even more by 2050, with 5.6 billion people living in cities in less developed nations (83% of the world's urban dwellers). On the contrary, urban population in more developed nations will account for 17% of the world's urban dwellers only (figure 2).⁸⁶

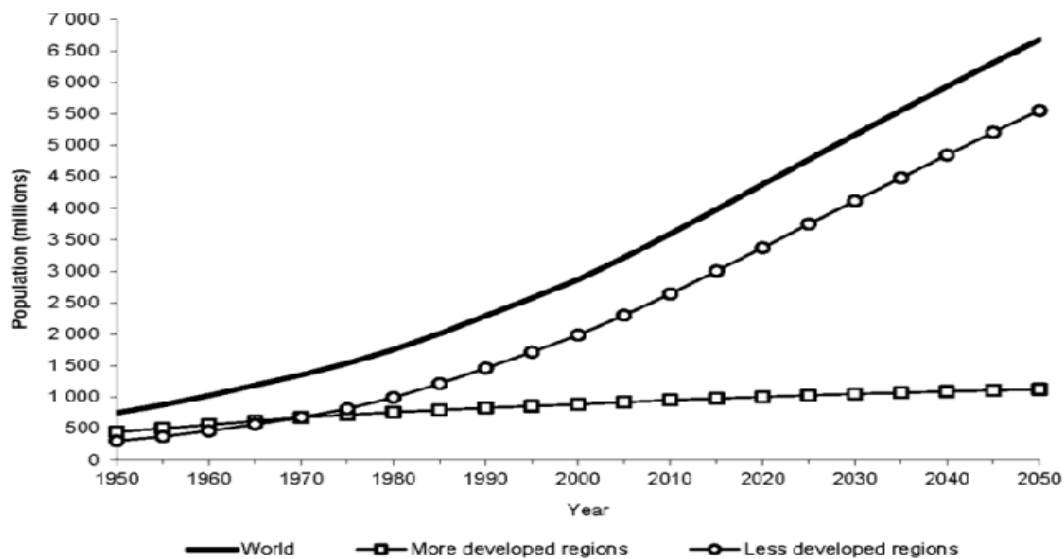


Figure 2. Urbanisation in developed regions and in less developed regions – numbers between 1950-2050

Urbanisation (population growth and migratory flows towards cities) can also contribute positively to urban development, because 80% of global GDP is generated in urban

⁸⁵ United Nations Department of Economic and Social Affairs (UNDESA). (2018). World Urbanisation Prospects: The 2018 Revision, UNDESA, p. 1. Retrieved from: <https://population.un.org/wup/Publications/Files/WUP2018-Report.pdf>

⁸⁶ Ivi, pp. 12-13

spaces. Yet, there are some problems concerning the mismanagement of cities, because the latest urbanisation trends have been rapid and constantly growing. Some challenges include meeting the demands for housing, transportation systems, primary services and infrastructures able to accommodate the ever-increasing urban people.⁸⁷

Moreover, often cities are too small to account for all the people living in, so there could be conflicts due to land use and necessity. Therefore, new urban land construction, added to population growth, unbalance the natural equilibrium of nature. Hence, one of the reasons why cities encapsulate warm, consuming the majority of global energy and emitting a great percentage of GHG, is precisely land maladministration linked to global warm.⁸⁸

Furthermore, concerning cities' size, another fundamental aspect is the growing number of large cities and their size in order to cope with urbanisation. In 19th century, there were only two cities with millions of inhabitants, namely London and Beijing. In 1950, the number grew up to 75, until reaching 380 cities in the year 2000, the majority of them being in low- and middle-income nations.⁸⁹ Thus, with the increase in the number of cities with more than a million inhabitants, also the size of cities grew. In 2000, the average size of the world's largest cities was 6.3 million urban dwellers, as opposed to 2 million in 1950 and less than one million in 1900.⁹⁰

In addition, the growing level of urbanisation is strictly linked to the globalisation of trade, that is to say the rapid expansion of international business. Indeed, there is a correlation between cities with more than a million inhabitants and the world's largest economies, which host these cities. Nowadays, growing flows of goods, information, technology and trade have created a framework of global cities, in which the globalisation of the economy takes place. Indeed, Tokyo, New York and London, for example, three of the most significant financial centres, are also three of the largest world's cities.⁹¹ Hence, a link between international investment and largest cities can be established.

⁸⁷ The World Bank. (2020, April 20). Urban Development, *The World Bank*. Retrieved from: <https://www.worldbank.org/en/topic/urbandevelopment/overview>

⁸⁸ Ibid

⁸⁹ Lankao, R., Huq, S., Pelling, M., Reid, H. & Satterthwaite, D. (2007, October 1). Adapting to Climate Change in Urban Areas. The possibilities and constraints in low- and middle-income nations, op. cit., p. 8

⁹⁰ Satterthwaite, D. (2007). The Transition to a Predominantly Urban World and its Underpinnings, *IIED Working Paper*, p. 1

⁹¹ Ivi, p. 39

1.3.2 Cities and global warming

Climate change affects different aspects of cities, such as economic development and infrastructure. The effects depend on the location, characteristics and adaptive capacities of cities. As already mentioned, climate change can induce to the displacement of people and therefore it can increase the internal and international migration. Infrastructures can also be damaged by direct impacts of climate change, in particular the water system, since saltwater intrusion can affect the quality of water supplies. Moreover, climate change can affect human health negatively, because it can increase the transmission of diseases, such as malaria, cholera and meningitis. Food production, on the one hand, can also be reduced by the effects of global warming, depending on precipitation patterns and temperatures. While, on the other hand, urbanisation and growing populations put more pressure on food production and water resources. It must be mentioned that, besides these consequences, one of the most serious implications of climate change locally and globally is of economic entity. In island countries, for example, the tourism sector can be hardly affected, due to sea-level rise in coastal areas, changing temperatures, disruptions to transport networks... Last but not least, climate change has severe social impacts, because it affects the most vulnerable part of the population, exacerbating poverty, gender and racial inequalities.⁹²

According to some scientists, cities are heating up in accordance with global warming. Life in cities is becoming dangerous for people, especially vulnerable groups, which comprehend basically the elderly, the sick, the poor. According to National Geographic, this phenomenon can be called “Urban Heat Island” (UHI) effect. UHI is nothing more than the increasing of heat waves in a metropolitan area compared to the rural area outside the city. The mechanism is straightforward: all the people living in the city, all the vehicles that move around it and all the industrial activity create energy, which in turn creates heat.⁹³ As envisaged by the United States EPA, the annual air temperature of a

⁹² United Nations Climate Change (UNCC): e-Learn. How does climate change affect cities? In Cities and Climate Change, online course. Adapted from United Nations Human Settlements Programme (UN-Habitat) Cities and Climate Change Academy modules for universities and from UN-Habitat Cities and Climate Change: Global Report on Human Settlements 2011. Retrieved from: <https://unccelearn.org/course/view.php?id=21&page=course>

⁹³ National Geographic. Urban Heat Island, In Resource Library: Encyclopedic Entry, *National Geographic*. Retrieved from: <https://www.nationalgeographic.org/encyclopedia/urban-heat-island/>

city inhabited by one million or more people can range from 1 to 3°C hotter than its rural surroundings.⁹⁴ There are two different types of UHI: surface UHI and atmospheric UHI. On the one hand, in surface UHI, solar radiations heat dry urban concrete surfaces from 27 to 50°C warmer than the air, while moist surfaces outside the city remain very close to air temperatures.⁹⁵ Surface UHI presents higher levels during daytime, because the sun heats dry surfaces, but they are subject to changes depending on the season. Indeed, surface UHI is more frequent during summer due to sun's intensity. On the other hand, atmospheric UHI refers to the difference between warmer air temperature in urban areas compared to cooler air in its rural surroundings. Usually, atmospheric UHI is weaker during daytime and stronger after sunset because of the slow heat release from buildings, roads, infrastructures present in the city.⁹⁶ Of course, the two different types of UHI are closely correlated due to the fact that surface temperatures contribute also to air temperatures. Indeed, surface areas rich in vegetation have cooler surface temperatures, and this contributes to cooler air temperatures also. It happens exactly the contrary with built-up areas.⁹⁷

The reasons of UHI development are different and, for the most part, lie in the structure of the city. First of all, more vegetation in urban centres avoid UHI phenomenon. Indeed, through a process of evapotranspiration, water evaporates from plants into the surrounding air, releasing heat. This mechanism does not happen in conventional urban areas, because the city is characterised by buildings and infrastructures in general. This results in ground covered with less moisture, which determines warmer areas, so that surfaces that were once wet become dry and impermeable; in broad terms, concrete constructions trap solar radiations during daytime and release them during night, that is why people feel the burden of heat waves.⁹⁸ Secondly, materials with which the urban

⁹⁴ US Environmental Protection Agency (EPA). (2008). Reducing Urban Heat Islands: Compendium of Strategies, *US Environmental Protection Agency (EPA)*, p. 1. Retrieved from: https://www.epa.gov/sites/production/files/2017-05/documents/reducing_urban_heat_islands_ch_1.pdf

⁹⁵ Berdahl, P. & Bretz, S. (1997). Preliminary Survey of the Solar Reflectance of Cool Roofing Materials, *In Energy and Buildings, Elsevier*, 5:2, pp. 149-158

⁹⁶ US Environmental Protection Agency (EPA). (2008). Reducing Urban Heat Islands: Compendium of Strategies, op. cit., p. 3

⁹⁷ Ibid

⁹⁸ Singer, M. (2018). *Climate Change and Social Inequality: The Health and Social Costs of Global Warming*, op. cit., p. 22

infrastructure is constructed are also important, such as solar reflectance, thermal emissivity or heat storage. In general, built-up areas reflect less solar energy and absorb more of it, causing heat to increase. Moreover, many buildings' materials, such as stone or steel, store heat, so cities keep much more solar energy than their rural counterparts. Thirdly, urban dimensions also count, for example, urban spacing. This means that usually, in metropolitan centres, there are obstructions caused by amassed neighbouring buildings, so that heat is trapped more easily. Fourthly, anthropogenic heat is another cause of UHI, basically it refers to heat produced by human activities, such as transportation, heating and cooling systems. Furthermore, also weather and geographic location can induce UHI.⁹⁹

Urbanisation contributes significantly to this circumstance, because when people overcrowd a city, activities grow. Furthermore, UHI worsens water and air quality, because of the pollutants circulating in the air due to the high-level of urbanisation and urban activities, and because of the increase in temperatures.¹⁰⁰

Urbanisation is evolving over and over at a fast pace all over the world, and this is augmenting the level of consumption of GHG. This is causing major problems to the well-being of urban population, but also to the economy worldwide.

Extreme temperature events are likely to happen more intensively in cities and urban centres, and they are expected to become a global concern if no international response will solve this problem step by step. This is a global issue with local implications, indeed, UHI intensity also depends on geography, society and economy. The so-called "heat-health" nexus depends on these different aspects.¹⁰¹

As a community, government and citizens should work together in order to reduce UHI impact on urban areas. As UHI effect is likely to happen more frequently during summer months, intense summer heat could therefore produce unbearable conditions for local citizens, as well as less touristic waves.

⁹⁹ US Environmental Protection Agency (EPA). (2008). Reducing Urban Heat Islands: Compendium of Strategies, op. cit., pp. 7-13

¹⁰⁰ National Geographic. Urban Heat Island, op. cit.

¹⁰¹ Breil, M., Ellena, M. & Soriani, S. (2020, July 22). The heat-health nexus in the urban context: A systematic literature review exploring the socio-economic vulnerabilities and built environment characteristics, op. cit., pp. 14-15

The United States EPA has drawn up some suggestions in order to reduce UHI consequences. In particular, it is necessary to build green infrastructures and improve sustainable urbanism projects; in addition, it is also important to plant trees and other vegetation, and to build green roofs in order to create garden cities able to release heat and to absorb pollutants.¹⁰² Indeed, some scholars have asserted: “ Green infrastructures may be incorporated in a variety of ways, including the creation of parks, tree planting along streets, and green roofs”.¹⁰³

1.4 World megalopolis and “connectography”

Nowadays, cities are expanding at a fast pace every day, so that they can even be called “megalopolis”. As previously stated, urbanisation increases the capacity of a city, because the majority of the population lives, and will live, in cities, but it also generates some challenges. According to the global strategist Parag Khanna, cities are: “[...] the infrastructures that most define us”.¹⁰⁴ Megacities are connected through a vast archipelago stretching hundreds of kilometres, thanks to globalisation and its means, such as transportation, communication networks, technology, energy, etc.¹⁰⁵

Vancouver, for example, stretches itself across the United States border to Seattle. Silicon Valley starts north of San Francisco down to San José and across Oakland Bay. Los Angeles now passes San Diego across the Mexican Border to Tijuana. San Diego and Tijuana now share an airport terminal. Eventually, a high-speed rail network may connect the entire Pacific spine. America’s north-eastern megalopolis starts in Boston through New York, Philadelphia, and ends up in Washington. They contain more than 50 million people together and also have plans for high-speed rail networks. On the opposite side of

¹⁰² US Environmental Protection Agency (EPA). (2020, November 2). Reduce Urban Heat Island Effect, *US Environmental Protection Agency (EPA)*. Retrieved from: <https://www.epa.gov/green-infrastructure/reduce-urban-heat-island-effect>

¹⁰³ Bowler, D. E., Buyung-Ali, L., Knight, T. M. & Pullin, A. S. (2010). Urban greening to cool towns and cities: A systematic review of the empirical evidence, In *Landscape and Urban Planning, Elsevier*, 97:3, p. 147

¹⁰⁴ Khanna, P. (2016). How megacities are changing the map of the world, *TEDx2016*. Retrieved from: https://www.ted.com/talks/parag_khanna_how_megacities_are_changing_the_map_of_the_world/details?referrer=playlist-our_future_in_cities#t-315129

¹⁰⁵ Ibid

the globe, Asia is the place where there are actually real megacities. Tokyo, Nagoya and Osaka clustered together contain more than 80 million people and they are the centre of Japan's economy. In China, actually there are megacities clusters coming together with population reaching 100 million people, such as Beijing, Shanghai and Chongqing-Chengdu megacity cluster, almost the same size of Austria. Also, India has a number of megacities nests, such as the Delhi capital region and Mumbai, and, in the Middle East, Tehran is encapsulating one third of Iran total population. The majority of Egyptian people live in the corridor between Cairo and Alexandria, and, in the Gulf region, city-states are forming, from Bahrain and Qatar, through the United Arab Emirates to Oman. Furthermore, there is Lagos, Africa's largest city in Nigeria, which has plans for a rail network in order to become the basis for an Atlantic coastal corridor extending across Benin, Togo, Ghana and Ivory Coast.¹⁰⁶

In a megacity world, countries can become the periphery of cities. By 2030, there will be about 50 megacity clusters in the world. It is difficult to understand any megacity without understanding its connections to the others. People move to cities in order to be connected, and connectivity is the reason why these cities are committed to address economic, social and cultural challenges together.¹⁰⁷

According to professor Khanna, the new maxim for the future is: "Connectivity is destiny". Connectivity has enabled a progress in the mobility of people, goods and services, knowledge and information. This precept is strictly connected to geography, up to assimilate them together in a unique word: "connectography".¹⁰⁸

1.4.1 "Connectography": a new global network for the future

As claimed by Parag Khanna, connectography is intended as:

A quantum leap in the mobility of people, resources, ideas. [...] An evolution of the world from political geography, which is how we legally divide the world, to functional geography, which is how we actually use the world, from nations and borders, to infrastructures and supply chains.¹⁰⁹

¹⁰⁶ Ibid

¹⁰⁷ Ibid

¹⁰⁸ Khanna, P. (2016). *Connectography: mapping the future of global civilisation*, op. cit., pp. 5-8

¹⁰⁹ Khanna, P. (2016). How megacities are changing the map of the world, op. cit.

Nowadays, our global system is evolving, from the empires of the 19th century to the interdependent nations of the 20th century into a global network civilisation in the 21st century. Indeed, connectivity has become the symbol of human activity. It is fundamental to assert that this new global network civilisation provides hope for fighting against climate change, social inequality and geopolitical rivalries. In the 21st century, Europe and Asia are not two different continents anymore, because Europe is building its infrastructures eastward, while China is building its infrastructures westward; basically, they are intersecting. For the first time, the entire human history is connected. Connectivity is so important that, without it, new generations will not be able to survive the 21st century. It is important to remember that young generations, which actually are growing up with a Gig Economy¹¹⁰, will probably work in the services economy, which refers to the fact that without being digitally connected people cannot do anything.¹¹¹

According to Bill Gates, today we are living in a world that is significantly better than before, because people live longer, nations are independent and communications are easier.¹¹² Globalisation has simplified connections. Today, countries are separated by legal geographical borders, but they are connected through the Information and Communications Technology (ICT) system.¹¹³

A world redrawn through connectography is a world that shifts from “us-them” way of thinking towards a broader term, such as “we” as connected human beings.¹¹⁴ Indeed, globalisation has improved the quality of life in general. However, inequality levels remain always high. Thus, connectography should help the community face some dangerous problems for the world and for the interactions amongst individuals, for example, inequality, pollution, scarcity of resources and wars.¹¹⁵

¹¹⁰ Economic model based on freelance work and short-term working contracts, contrary to permanent contracts. The term was first coined by the journalist Tina Brown in “The Daily Beast” in 2009, and then it developed also in the United States, until reaching all countries

¹¹¹ Khanna, P. (2016, October 5). What is connectography? *Temasek Digital*. Retrieved from: <https://www.youtube.com/watch?v=k-Ftn9ESoxM>

¹¹² Gates, B. (2014). Annual Letter 2014, *Bill & Melinda Gates foundation*. Retrieved from: <https://www.gatesfoundation.org/ideas/annual-letters>

¹¹³ Khanna, P. (2016, October 5). What is connectography? Op. cit.

¹¹⁴ Khanna, P. (2016). *Connectography: mapping the future of global civilisation*, op. cit., pp. 383-384

¹¹⁵ Ibid

Infrastructures, ICT, open markets are bringing people towards a sustainable future, but there is the need of more cooperation in order to achieve it, and it is an imperative to overcome social problems and instabilities now and in the years to come.

CHAPTER II

Overcoming climate change problem: green and sustainable cities

In the postindustrial age, we have realised that the industrial revolution brought with it a number of problems, in addition to the economic and social development. These concerns range from environmental to health ones. Nowadays, since the population has increased in urban areas, and new industries have been built, pressures on our ecosystem have reached the critical point. As already asserted in the first chapter, problems are no longer local, but they have become global.¹¹⁶

Direct impacts of climate change can be seen in melting glaciers, rapid sea level rise, drought, intense heat waves and frequent climate change related phenomena, such as storms or flooding.¹¹⁷

According to the IPCC, temperature forecasts will rise from 2.5 to 10 degrees Fahrenheit over the next century.¹¹⁸

One possible solution at local, national and international level is the creation of green and sustainable cities in order to guarantee better living standards for the population. As stated by Andrew Steer, President and Chief Executive Officer of the World Resource Institute, “The battle against climate change will be fought in cities. Cities can be the problem or cities can be the solution. But we need to know what is going on in the cities. What you measure, you treasure”.¹¹⁹

¹¹⁶ Johnson, H. D. (2008). *Green Plans: blueprint for a sustainable earth*, University of Nebraska Press, p. 4

¹¹⁷ NASA Global Climate Change. (2021, July 27). The Effects of Climate Change, *NASA Global Climate Change*. Retrieved from: <https://climate.nasa.gov/effects/>

¹¹⁸ Ibid

¹¹⁹ Steer, A. (2014, December 8). Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). On Monday, 8 December 2014, the World Resources Institute (WRI), C40 Cities Climate Leadership Group (C40) and ICLEI-Local Governments for Sustainability (ICLEI) organised an event at UNFCCC COP20 to launch the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). Retrieved from: <https://vimeo.com/114001116> (this video by IISD Reporting Services provides an overview of the GPC, which is a tool that enables cities to report all of their GHG emissions through one single method. Produced by Nicole de Paula and filmed/edited by Elizabeth Press)

According to the C40 Cities Climate Leadership Group¹²⁰, cities represent the key to address climate change problems. The reasons for this statement might seem complicated, but, in reality, they are very basic: cities have always been the centre of innovation; thus, they have the potential to change the world. Nevertheless, cities present also some vulnerabilities related to the ever-increasing rate of urbanisation, but also to the direct effects of climate change, such as flooding, high tides and frequent storms in coastal cities. These effects cause financial damage to the urban centre, too, since reconstruction operations can lead to major financial disruptions. However, urban density can create the possibility for better standards of living through efficient urban planning. It is important to acknowledge that local actions can make the difference, since they can have immediate impacts and add up to create global effects.¹²¹

Collaboration between C40 Cities is making a difference in improving climate action, starting from cities. Indeed, cities represent our future, since the majority of humans will live in urban spaces, thus it makes sense that solutions to climate change start there.¹²²

A relationship between people and places exists. Environmental design seeks to create better living conditions for the humanity. Hence, the key for green urban design is the ability to connect people with nature. Indeed, the majority of the population sees the city as a possible solution for a number of environmental problems.¹²³

Since cities are centres of development and innovation thanks to diverse cultural and social networks, close exchange between science and industry, etc., they are therefore the ideal place to test solutions for climate change mitigation and adaptation.¹²⁴

This chapter aims at explaining the reason why green and sustainable cities are so important for the human condition, and what measures cities have taken so far in order to fight climate change. It starts with clarifying the concept of “green city”, followed by the description of the six most important green cities’ development criteria, namely security

¹²⁰ C40 Cities is a network of 97 megacities around the world which aim is to focus on fighting climate change through urban action. Website: <https://www.c40.org>

¹²¹ C40 Cities. (2012). Why cities? Ending climate change begins in the city, *C40.org*. Retrieved from: <https://www.c40.org/ending-climate-change-begins-in-the-city>

¹²² Ibid

¹²³ Blewitt, J. (2018). *Understanding Sustainable Development*, op. cit., pp. 256-258

¹²⁴ United Nations Climate Change (UNCC): e-Learn. Transformative role of cities, op. cit.

for the population, pollution prevention, an efficient infrastructure system, resource efficiency, sustainable urbanism and innovative technology.

However, green cities have also some drawbacks; hence, a comparative description of benefits and disadvantages is highlighted in this section.

The chapter concludes explaining the reason why eco-cities are a possible solution to climate change, because they are conceived as the cities of the future, and it depicts Asia as an example for the rest of the world in the field of greening. According to UN-Habitat's report "Planning for Climate Change 2014", "Fundamentally, good city planning practices are, by their nature, also climate smart planning practices".¹²⁵

¹²⁵ United Nations Human Settlements Programme (UN-Habitat). (2014). Planning for Climate Change, p. 23. Retrieved from: <https://unhabitat.org/sites/default/files/download-manager/files/Planning%20for%20Climate%20Change.pdf>

2.1 The meaning of “Green City”

In 1987, the United Nations World Commission on Environment and Development issued a document, entitled “Our Common Future”, known as the Brundtland Report¹²⁶, in order to address the problem of the perilous state of the environment. During the preparation of this document, the term “sustainable development” was coined and it is now used all around the world. The Brundtland Report itself gave impetus to the Green Plan¹²⁷ in the countries which are now adopting it. Indeed, the Green Plan has the specific aim of achieving sustainable development.¹²⁸

Green growth has recently emerged as a new paradigm in order to challenge environmental and climate threats. Cities represent one of the pillars of the green growth debate, indeed, the city per se is the centre of economic activities and, at the same time, the driver of power consumption and GHG emissions. Thus, green growth combines economic development with environmental damage, providing a way to rethink the economic and sustainable model. Nowadays, energy efficiency, social equality, sustainability and greening are strictly interconnected.¹²⁹

The term “green” is used in order to address some key concepts, such as the need to protect our ecosystem from the turbulent environment that surrounds us or as resource efficiency, for example. Hence, the need to balance resource use with consumption is clear.¹³⁰

“Green” has a broad meaning, which varies from the environmental level, such as waste management and recycling, energy use, sustainable buildings and infrastructures construction, natural resource management, etc., to the business level.¹³¹

¹²⁶ The Brundtland’s report takes the name after the UN World Commission on Environment and Development’s chair, former Norwegian prime minister Gro Harlem Brundtland

¹²⁷ The Green Plan is a long-term environmental strategy with the aim of achieving environmental quality, security and sustainability, protection and conservation of natural goods and resources

¹²⁸ Johnson, H. D. (2008). *Green Plans: blueprint for a sustainable earth*, op. cit., p. 29

¹²⁹ Hammer, S., Kamal-Chaoui, L., Plouin, M. & Robert, A. (2011). Cities and Green Growth: A conceptual Framework, *OECD Regional Development Working Papers*, pp. 11-16

¹³⁰ Carley, S., Lawrence, S. (2011). Energy-based Economic Development, op. cit., pp. 292-295

¹³¹ Ibid

A major focus must be given to “green cities”. Green cities are cities whose purpose is to achieve a “win-win situation, manageable futures and prosperous development with rather than against nature”.¹³²

In October 2007, during the Seventeenth National Congress of the Chinese Communist Party in Beijing, the ecological transition was recognised as the main national goal, overcoming the previous economic-centred development model and aiming at improving environmental health. Indeed, a change was necessary in order to challenge environmental problems and to reduce GHG emissions. Hence, in 2008 the green cities (or eco-cities) programme was launched in China, identifying a series of projects which involve the major Chinese cities.¹³³

Since the majority of the world’s population is expected to be living in urban areas by 2050, as it is abovementioned in the first chapter, many countries have adopted the concept of eco-city as a form of sustainable urbanism. Moreover, climate crisis, health risks, high levels of urbanisation, security concerns resulted in the development of the green concept.

An eco-city should be a genuine and socially equitable place available to all the people. Cities and their population play an important role in achieving urban sustainability.¹³⁴

The term eco-city is recent. It can be traced back to the mid-1970s, when environmental movements were arising. A first wave of eco-city initiatives took place since the development of the UN first Earth Summit in Rio de Janeiro in 1992, and the subsequent sustainable development programme of the Agenda 21. Curitiba (Brazil), Waitakere (New Zealand) and Schwabach (Germany) are some examples of the first eco-cities.¹³⁵ Since this concept has become a necessity over time, in the 2000s the eco-city initiative

¹³² Harvey, N., Pow, C. P. (2015). Eco-cities and the Promise of Socio-Environmental Justice, op. cit., pp. 401-414

¹³³ Oswald, J. (2016, August 3). China Turns to Ecology in Search of ‘Civilisation’, *Asian Studies Association of Australia*. Retrieved from: <https://asaa.asn.au/china-turns-to-ecology-in-search-of-civilisation/>

¹³⁴ Tan-Mullins, M. (2018). Who are green cities actually for? In GREEN CITY: Explorations and Visions of Urban Sustainability, *RCC Perspectives*, 1, pp. 33-38

¹³⁵ Cowley, R., Joss, S. & Tomozeiu, D. (2011, September). Eco-cities – A Global Survey 2011, International Eco-cities Initiative, *University of Westminster*, p. 1

proliferated and gained major stimulus.¹³⁶ In a survey of urban climate change experiments in 100 cities, it was discovered that the construction of 79% of these cities began after the ratification of the Kyoto Protocol in 2005. In this survey, it was asserted that: “[...] Climate change has gained more visibility in the city at the same time as the agreements took place”.¹³⁷ Indeed, the UN international conferences and agreements on climate change, which took place until nowadays, have focused their attention on the role of cities in challenging climate change and environmental risks.

Actually, there are many examples of cities implementing innovative solutions. Ecocasa Project in Nuevo Leon, Mexico, represents an example of transformative city. It is implemented by the Mexican government in partnership with international development banks, which encourage housing developers to build up houses designed in order to minimise GHG emissions. The case is particularly interesting because it includes low-income housing, demonstrating that sustainability is compatible with affordability.¹³⁸ Another example is the Green Lighting Programme in Beijing, China. It was initiated in 2004. One of its main objectives focuses on replacing normal lights with energy-efficient lights in over 2000 schools. The result was that it reduced annual CO₂ emissions by 14,535 metric tonnes, and it also saved 14.4MW of electricity valued US\$1.05 million.¹³⁹

Eco-city development since 2000s took place in the Global South mainly, especially in emerging countries such as India and China, rather than in Europe and North America. This explains the fact that eco-city projects are conceived as a reflection of high rates of urbanisation in emerging countries.¹⁴⁰

¹³⁶ Abo El-Enien O. M., Elrayies, G. M., Mahmoud, M. F. & Yakoub, W. A. (2019, March 16-20). Ambassadors of Sustainability: An Analytical Study of Global Eco-Friendly Cities, *Menoufia University, Faculty of Engineering*, pp. 1-2

¹³⁷ Castán Broto, V., Bulkeley, H. (2013). A survey of urban climate change experiments in 100 cities. In *Global Environmental Change, Elsevier*, 23:1, p. 96

¹³⁸ United Nations Climate Change (UNCC): e-Learn. Transformative role of cities, In *Cities and Climate Change*, online course. Original source Momentum for change. Retrieved from: <https://unccelearn.org/course/view.php?id=21&page=course>

¹³⁹ Ibid. Original source Zhao, J. (2010). Climate change mitigation in Beijing, China, Unpublished case study prepared for the UN-Habitat Cities and Climate Change Global Report on Human Settlements 2011.

¹⁴⁰ Caprotti, F. (2017). Emerging low-carbon urban mega-projects. In Dhakal, S., Ruth, M. (eds), *Creating Low Carbon Cities*, Berlin: Springer, pp. 51-54

Green cities are envisaged as experimental sites, not only with new technologies, but also with economic-environmental reforms in order to transform the city into a low-carbon economy.¹⁴¹ Indeed, they have two main goals: to ensure the development of sustainable urbanism and to stimulate the growth of an energy-efficient economy.

Actually, there is not a unitary definition of “eco-city”, instead, this concept includes a variety of projects with the purpose of transforming urban areas into green spaces.¹⁴²

2.2 Green cities’ development criteria

The green city development requires a deep interaction between economic, political, social, cultural and environmental factors based on ecological pillars, fundamentally. The health of people and the quality of life are two of the major criteria of an efficient eco-city. Both these factors are complementary to the maintenance of the ecosystem.¹⁴³

Sectors playing an important role for urban emissions, and thus for people health and quality of life, are energy supply for electricity generation, transport, industry, and commercial and residential buildings, since a vast number of fossil fuels are used in order to produce energy. As a consequence of this, cities are trying to implement efficient management systems in order to reduce GHG emissions.¹⁴⁴

The ideal green city has been targeted following these characteristics: resource efficiency; zero-carbon and renewable energy production; a well-planned transportation system, which prioritises walking and cycling; restoration of damaged and obsolescent urban areas; improvement of job opportunities and of housing for all the people, in particular for the disadvantaged ones, and support for social inclusion; promotion of local

¹⁴¹ Caprotti, F. (2014). Eco-urbanism and the Eco-city, or, Denying the Right to the City? *Antipode*, 46:5, pp. 1285-1303

¹⁴² Caprotti, F. (2017). Emerging low-carbon urban mega-projects, *op. cit.*, p. 56

¹⁴³ Sarkar, A. N. (2016). Eco-innovations in Designing Eco-cities and Eco-towns, *op. cit.*

¹⁴⁴ United Nations Climate Change (UNCC): e-Learn. Sectors playing an important role for urban emissions, In *Cities and Climate Change*, online course. Adapted from United Nations Human Settlements Programme (UN-Habitat) Global Report on Human Settlements, 2011: *Cities and Climate Change* and UN-Habitat Global Report on Human Settlements, 2013: *Planning and Design for Sustainable Urban Mobility*. Retrieved from: <https://unccelearn.org/course/view.php?id=21&page=course>

agriculture and sustainable lifestyles. Furthermore, the green city must evolve at the same time as the population grows and as the need of the citizens change.¹⁴⁵

Eco cities' development criteria comprehend a variety of fields, from security to technology, all seen from an ecological perspective.

2.2.1 Security for the population

Security is at the basis of politics and history. Indeed, it connects communities, societies and nations, and it constitutes a common need. For a long time, security has been related to the military field, while, in recent times, it has been closely connected with the environment.¹⁴⁶

We have seen that the postindustrial age, which in a way delivered new technological and comfortable innovations, has brought along with it more pollution and environmental disasters, leading to health risks also. Health and environment, therefore, are important factors for what concerns personal and national security. These kinds of problems have now become global; thus, our attention as citizens of the Earth must be focused on achieving ecological security. Countries which adopted the Green Plan are successfully moving towards sustainability, which is a necessary condition for achieving health and security.¹⁴⁷

According to the International Peace Research Association (IPRA) Commission on Ecological Security, there are three different ways to define ecological security. The first one is nature-centric, and it focuses on the study of nature as an entity. It highlights the importance of establishing an association amongst organisms at the micro-level and between organisms and their ecosystems at the macro-level. The second one is a human-centric definition. It conceives humans as the major players who affect nature. It focuses on the role of international organisations and how they affect international ecological security through their means, such as policy making and international law. The third approach is wide-ranging, in the sense that it considers ecological security as part of a broad system: ecosystems, social systems, humans, technology. Indeed, nowadays

¹⁴⁵ Sarkar, A. N. (2016). *Eco-innovations in Designing Eco-cities and Eco-towns*, op. cit.

¹⁴⁶ Johnson, H. D. (2008). *Green Plans: blueprint for a sustainable earth*, op. cit., p. 49-51

¹⁴⁷ Ibid

environmental problems have a global dimension. Hence, international cooperation is necessary in order to find common solutions.¹⁴⁸

There is a debate between scholars who think about climate change as a threat for national security¹⁴⁹, and the ones who think that global warming affects the lives of vulnerable populations.¹⁵⁰ It is difficult to decide which is the best approach to follow, indeed, this is a matter of dispute.

In August 2016, the word “Anthropocene” was formally adopted by the Working Group on the Anthropocene in order to designate the contemporary epoch in which we are living. Such word was presented to the 35th International Geological Congress which took place at the beginning of September 2016 in Cape Town.¹⁵¹ According to the authors of the International Geosphere-Biosphere Programme (IGBP), the word Anthropocene refers to the fact that:

Human activities are now so pervasive and profound in their consequences that they affect the Earth at a global scale in complex, interactive and accelerating ways; humans now have the capacity to alter the Earth System in ways that threaten the very processes and components, both biotic and abiotic, upon which humans depend.¹⁵²

Actually, green cities are trying to maximise human health, while designing green buildings, green spaces (e.g. parks), an innovative infrastructure and transportation system and an efficient use of energy and resources. Green buildings are designed in order to interconnect different factors involved in the design, construction and effective use of buildings to use energy and water resources efficiently. The adoption of green buildings would create important benefits in the long-run, including energy and water savings, less

¹⁴⁸ International Peace Research Association (IPRA) Commission on Ecological Security. (1995, March). *Newsletter*, 95:1

¹⁴⁹ Busby, J. (2007). Climate change and National Security: An Agenda for Action, *Council on Foreign Relations*, Council Special Reports (CSR) no. 32, pp. 1-27. Retrieved from: https://cdn.cfr.org/sites/default/files/report_pdf/ClimateChange_CSR32%20%281%29.pdf

¹⁵⁰ Barnett, J., Matthew, R. A. & O'Brien, K. (2010). *Global Environmental Change and Human Security*, Cambridge, MA: MIT Press, pp. 3-21

¹⁵¹ McDonald, M. (2018, July). Climate change and security: Towards ecological security? In *International Theory*, Elsevier, 10:2, p. 165

¹⁵² Jäger, J. et al. (2004). *Global Change and the Earth System: A Planet Under Pressure*, I Ed., Heidelberg, Germany: Springer, p. 1

CO₂ emissions, renewable energy from on-site systems, improvement of health standards, increase in financial savings, etc.¹⁵³

2.2.2 Pollution prevention

Pollution prevention is one of the most relevant green cities' development criteria. Air and water pollution affect air and water quality, respectively.

A number of studies have shown that exposure to air pollution, in particular, can seriously influence the health of people and the equilibrium of ecosystems. Nevertheless, air pollution is controlled mainly through local direct regulations, such as specific targets for fuel quality used by industries and by the transport sector, and air quality standards and goals for preserving our health and nature. Other instruments for pollution prevention are carbon taxation and cap and trade¹⁵⁴, for example. They are more cost-effective compared to regulations, because they provide economic incentives to the market in order to reduce the emissions of pollutants.¹⁵⁵

For what concerns water pollution, cities can provide natural systems in order to treat contaminated water. Those systems can include land treatments and constructed wetland treatments. The latter are important, because they are cost-effective. Indeed, they exploit natural processes in order to improve water quality. One of the most important natural wetlands' functions is to filtrate water. Pollutants remain trapped by vegetation or they are transformed into inactive forms. Moreover, wetlands foster the conditions for microorganisms to live there, and, through a series of processes, they remove pollutants from the water.¹⁵⁶ Hence, wastewater management is an important part of the circular

¹⁵³ Braman, J., James, M. & Kats, G. (2010). *Greening Our Built World: Costs, Benefits, and Strategies*, Washington: Island Press, p. xv-xviii and pp. 171-187

¹⁵⁴ Cap and trade refers to a government regulatory programme conceived in order to limit, or cap, the total level of emissions of GHG. It is an alternative to carbon taxation

¹⁵⁵ Hammer, S., Kamal-Chaoui, L., Plouin, M. & Robert, A. (2011). *Cities and Green Growth: A conceptual Framework*, op. cit., p. 63

¹⁵⁶ US Environmental Protection Agency (EPA). (2004, August). *Constructed Treatment Wetlands, US Environmental Protection Agency (EPA)*. Retrieved from: <https://nepis.epa.gov/Exe/ZyPDF.cgi/30005UPS.PDF?Dockkey=30005UPS.PDF>

economy¹⁵⁷. It can be used efficiently for agriculture and industry, having positive effects on water supplies, human and environmental health and economy, supporting the development of a green economy. Thus, polluted water management brings environmental and economic benefits to the market and to the population.

Nowadays, there is the urgent need of water resources, in particular in developing countries. Wastewater management can enhance this difficult situation, through reuse of water.¹⁵⁸

Water management is part of the SDGs of the Agenda 2030, namely Goal number 6 - Clean Water and Sanitation. It pays particular attention to water quality, sanitation, water efficiency and water scarcity, wastewater management and international cooperation on water use.¹⁵⁹

In order to achieve Goal 6 by 2030, it is necessary to invest in new green infrastructures and innovative technologies to improve the wastewater management system.

2.2.3 Infrastructure system

GHG emissions in cities are attributable to a variety of sources, which comprehend transportation, energy use, waste, water, air and acoustic pollution. It is worth mentioning that transportation emissions are inversely proportional to urban density; indeed, cities with less urban density, but with a strong concentration of automobiles, have higher emissions than more densely composed urban centres with substantial public transportation. Energy use depends on climate, for example hot days require more energy used in air conditioning, but it can also depend on the quality of building's materials and on the quantity of concrete used. Pollution from waste, water, air and noise, which are

¹⁵⁷ The circular economy aims at defining growth through decoupling economic activity from the consumption of finite resources, designing out waste and pollution from the economy, recycling materials and regenerating natural systems

¹⁵⁸ United Nations World Water Assessment Programme (UNWWAP). (2017). Wastewater: The Untapped Resource, *The United Nations World Water Development Report 2017*, Paris: UNESCO, pp. 21-22. Retrieved from: <http://www.unesco.org/new/en/natural-sciences/environment/water/wwap/wwdr/2017-wastewater-the-untapped-resource/>

¹⁵⁹ United Nations General Assembly (UNGA). (2015, September 25). Transforming our world: the 2030 Agenda for Sustainable Development, *Resolution adopted by the General Assembly on 25 September 2015*, A/70/L.1, New York: UNGA, p. 18. Retrieved from https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

significant for cities in the developing world, primarily depend on human activities and on the quantity of pollution captured by the atmosphere. Overall, urban GHG emissions depend on a variety of infrastructure systems.¹⁶⁰

The Organisation for Economic Cooperation and Development (OECD) argued that:

Infrastructures are at the very heart of economic and social development. They provide the foundations for virtually all modern-day economic activity, constitute a major economic sector in their own right, and contribute importantly to raising living standards and the quality of life.¹⁶¹

Hence, infrastructures are very important for the development of a society and its economy. In addition, environmental development can be added to social and economic development.¹⁶²

The infrastructure system of a city aims at supporting the basic needs represented by the Universal Declaration of Human Rights of 1948.¹⁶³ Article 13 of the declaration itself refers to the freedom of movement and residence within a country and outside the borders; article 23 mentions the right to work and to have dignified working standards for everyone; article 25 points out the right to healthy and prosperous standards of life, including food, clothing, housing, sanitation and other social services, and the right to security; article 26 refers to the right to education.¹⁶⁴ Actually, these fundamental needs are supported by the modern infrastructure system, namely transport, energy and water services.

Nevertheless, infrastructures also have some disadvantages. Urbanisation is one of the major challenges, because the concentration of people in the urban centre may create

¹⁶⁰ The International Bank for Reconstruction and Development & The World Bank. (2010). *Energy efficient cities. Assessment Tools and Benchmarking Practices*, Washington D. C.: The World Bank, pp. 165-166

¹⁶¹ Organisation for Economic Co-operation and Development (OECD). (2006). *Infrastructure to 2030: Telecom, Land Transport, Water and Energy*, Paris: OECD Publishing, p. 15

¹⁶² Ness, D. (2007, May 27). Smart, sufficient and sustainable infrastructure systems, background paper for a UN Expert Group Meeting (EGM) on Sustainable Infrastructure Development (SID) held in Bangkok, 11-13 June, 2007, pp. 6-7

¹⁶³ Ibid

¹⁶⁴ United Nations General Assembly (UNGA). (1948, December 10). Universal Declaration of Human Rights (UDHR), Resolution 217/A, Paris. Retrieved from: <https://www.un.org/en/about-us/universal-declaration-of-human-rights>

logistic problems connected to traffic and noise pollution, for example. Moreover, power plants may cause an increase in GHG emissions, dams may imply the destruction of important natural sites, and the migration of people, together with the construction of buildings, may obstruct the city.¹⁶⁵

Nowadays, and over the next decades, environmental pressures are increasing, changing abruptly climate conditions. In order to respond to environmental challenges, a system of sustainable infrastructure development (SID) should be adopted.¹⁶⁶ In 2019, the Economist Intelligence Unit, supported by the United Nations Office for Project Services (UNOPS), highlighted that, in order to challenge environmental problems, it is necessary to build green infrastructures, design smarter cities, invest in efficient public transport systems and push for an innovative system of ICT.¹⁶⁷

Eco-efficiency is the key factor in order to achieve better life conditions for all the population. It is achieved by reducing the Ecological Footprint¹⁶⁸ and by achieving green growth. Thus, it is a way to reach sustainable urbanism and sustainable development overall.

2.2.4 Resource efficiency

Resource efficiency is a factor of utmost importance for a green city to develop. It is also linked to infrastructures, because one of the most challenging problems cities are facing is to meet primary resources' demand (e.g. energy, water). Thus, investments in infrastructure improvement are conceived as a priority.

For what concerns energy, eco-cities aim at employing renewable energy sources, such as solar energy, wind energy, hydro energy, etc.¹⁶⁹

Cities are the places where energy use takes place for the most part. Hence, cities are trying to act in order to use energy efficiently and to shift to cleaner energy sources.

¹⁶⁵ Organisation for Economic Co-operation and Development (OECD). (2006). *Infrastructure to 2030: Telecom, Land Transport, Water and Energy*, op. cit., p. 14

¹⁶⁶ Ness, D. (2007, May 27). Smart, sufficient and sustainable infrastructure systems, op. cit., pp. 13-14

¹⁶⁷ Murray, S. (2019). The critical role of infrastructure for the Sustainable Development Goals, *The Economist Intelligence Unit*, pp. 16-17

¹⁶⁸ The Ecological Footprint measures the amount of natural capital needed in order to produce the resources necessary to support a particular lifestyle

¹⁶⁹ Sarkar, A. N. (2016). Eco-innovations in Designing Eco-cities and Eco-towns, op. cit.

Actually, they rely on policies that aim at improving energy efficiency and conservation through innovations, non-fossil fuel sources of energy (e.g. renewable energy) and transition to less carbon-intensive fuels (e.g. natural gas). Certainly, the strategies used in order to achieve energy efficiency change depending on geography, policy, economy and natural resources of a city. Nevertheless, the use of on-site renewable energy technology, such as solar photovoltaic or wind turbines, and the introduction of the “smart grid” are changing the urban generation and distribution of power and will have a prominent role in the future.¹⁷⁰

Smart grids are fundamental in order to use energy efficiently, namely reducing the use of primary power. Smart grids are bidirectional power grids capable of linking the activities of all connected users, both producers and consumers, thus allowing energy to be distributed in an efficient, sustainable, cost-effective and safe way. These grids are a valuable device for reducing the environmental impact of the electricity system and, at the same time, they increase its safety and reliability through the provision of real-time information.¹⁷¹

According to Our World in Data, a scientific publication site based on research and data to show and to challenge global problems, renewable energy includes electricity production from hydro power, solar power, wind power, biomass, waste management and geothermal power. In 2021, the editorial site published a global map in order to demonstrate the share of electricity production from renewables all over the world in 2020. The research was based on BP Statistical Review of World Energy & Ember (2021). These data are shown in figure 3 below.¹⁷²

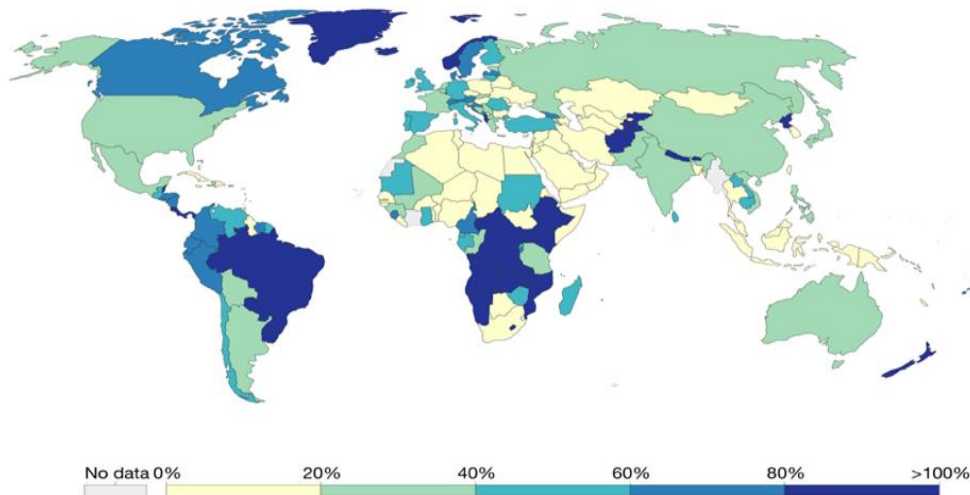
¹⁷⁰ Hammer, S., Kamal-Chaoui, L., Plouin, M. & Robert, A. (2011). Cities and Green Growth: A conceptual Framework, op. cit., pp. 47-48

¹⁷¹ Berloco, M. (2014/2015). Smart Cities: Green Economy, Innovazione e Sostenibilità nelle città del futuro, Tesi di laurea in Economia e Gestione dei Servizi di Pubblica Utilità, *Luiss Guido Carli*, pp. 9-10

¹⁷² Our World in Data. (2021). Share of electricity production from renewables, 2020, *BP Statistical Review of World Energy & Ember (2021)*. Retrieved from: <https://ourworldindata.org/grapher/share-electricity-renewables?country=~ETH>

Share of electricity production from renewables

Renewables includes electricity production from hydropower, solar, wind, biomass, and waste, geothermal, wave and tidal sources.



Source: Our World in Data based on BP Statistical Review of World Energy & Ember (2021)

OurWorldInData.org/energy • CC BY

Figure 3. Share of electricity production from renewables, 2020

Another important factor which characterises a green city is the construction of green buildings. The primary benefit of green buildings is the reduction of energy costs through energy efficiency. However, the opportunity for achieving energy efficiency in buildings is not equally distributed all over the globe. A United Nations Environment Programme (UNEP) study highlights that in developing regions there is an important gap between current emissions and projected emissions reduction. This reflects the rapid economic growth of these countries and their need for energy.¹⁷³

Concerning the water sector, water security is recognised as a significant issue nowadays. Some regions of the world face more challenges concerning water security than other countries do. Asia-Pacific region, for example, have the lowest availability of freshwater in the world, as a result of overpopulation and misuse/overuse of the supply. Moreover, the high level of urbanisation and the waste production related to it contribute to accessible freshwater pollution.¹⁷⁴

The efficient use of water resources is critical to achieve green growth. Indeed, water has always been an important primary resource for meeting basic human needs, but also

¹⁷³ United Nations Environment Programme (UNEP). *Towards a green economy: pathways to sustainable development and poverty eradication*, UNEP, corp. ed., pp. 350-351

¹⁷⁴ Asian Development Bank (ADB). (2012, November). *Green Cities*, Mandaluyong City, Philippines: Asian Development Bank (ADB), pp. 220-222

for economic growth. Wastewater management, as already mentioned, is a fundamental concern, because it affects the ecosystem.¹⁷⁵

The most appropriate water infrastructure planning must consider the impacts of climate change on the water supply, such as flooding, droughts, tides, etc. For this reason, the most appropriate water infrastructure depends on the local context. In general, adopting a specific water treatment system depending on the context and using an integrated approach is important. Thereby, coordination between centralised and decentralised water management systems, based on the context, is a pillar for reaching eco-efficiency in the water sector.¹⁷⁶

Another important factor is the policy coordination. An eco-efficient use of water resources requires a shift towards integrated policy approaches. Furthermore, it necessitates a shift in infrastructure, from centralised and single-use to decentralised and multi-use. Policies and infrastructures must integrate water supply, wastewater management, recycling and flood control measures in order to reach ecological and economic efficiency, and it is essential to ensure a full-cost recovery through water pricing (e.g. Singapore tariff system).¹⁷⁷

2.2.5 Sustainable urbanism

“Sustainable urbanism” is:

Walkable and transit-served urbanism integrated with high-performance buildings and high-performance infrastructure; where compactness and human access to nature are core values and where aspects of sustainability, functionality and interconnectivity are more important than design. ... “Sustainable Urbanism” is not only the approach how sites are designed and managed - it is furthermore a comprehensive network and agenda of interdisciplinary focused stakeholders - planners, architects, engineers, etc.

¹⁷⁵ United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). (2012). *Low Carbon Green Growth Roadmap for Asia and the Pacific. Turning resource constraints and the climate crisis into economic growth opportunities*, Bangkok: UNESCAP, p. 123

¹⁷⁶ Ivi, p. 124

¹⁷⁷ Ivi, pp. 125-126

... It has - and ... [it] will have - reforming influence on the whole planning and developing community.¹⁷⁸

According to this definition, sustainable urbanism entails a variety of concepts, establishing an interdisciplinary network of actors.

Indeed, social, economic, political and environmental sustainability must be integrated with urban sustainability. However, in particular in developing countries, it is not frequent that innovation and implementation of creative responses take place. It is difficult to address both livability and sustainability challenges through development programmes, because there are a number of challenges to consider, such as poverty, inequality, poor sanitation and education system. As seen above, the city of Curitiba, in Brazil, has become a model for it, because it addresses environmental and social problems together.¹⁷⁹

Sustainability requires respectable standards of living for everyone in the present without compromising future living standards. Sustainability is also linked to equity, that is social justice, a better quality of life for all the people, no discrimination between countries, etc. The main goals of sustainable development are: eradication of poverty, shifting from unsustainable models of production and consumption to sustainable ones, protecting the ecosystem through a fair management of natural resources, reaching economic and social development.¹⁸⁰

A fundamental way for reaching sustainability is the creation of green cities, since the majority of the world's energy production (60%-80%) occurs in cities and the rapid urbanisation process, in particular in the developing world, implies more pollution.¹⁸¹

Green cities are conceived as a response to these concerns. In the declaration of the World Ecocity Summit of 2008, which took place in San Francisco, it is stated that: "... Cities in which we live must enable people to thrive in harmony with nature and achieve sustainable development. ... Ecocity development requires the comprehensive understanding of complex interactions between environmental, economic, political and

¹⁷⁸ Milosovicova, J. (2008, July 7). Douglas Farr: Sustainable Urbanism. *Urban Design with Nature, TU Berlin*, p. 17

¹⁷⁹ United Nations Environment Programme (UNEP). (2012). *Sustainable, Resource Efficient Cities – Making It Happen!* UNEP, p. 44

¹⁸⁰ United Nations Environment Programme (UNEP). (2016). *The ABC for sustainable cities. A glossary for policy makers*, UNEP, pp. 44-45

¹⁸¹ Alusi, A., Eccles, R. G., Edmondson, A. C. & Zuzul, T. (2011, March 20). Sustainable Cities: Oxymoron or the Shape of the Future? *Op. cit.*, p. 2

socio-cultural factors based on ecological principles”.¹⁸² This definition emphasises the importance of eco-cities in finding a solution for environmental problems, highlighting the need for establishing interactions amongst multiple factors and the matter of urban planning shift towards a green solution.

2.2.6 Technology (Smart Cities)

The rapid urbanisation process of the 21st century puts the typical settlement pattern into a difficult situation, and it supposes deep transformations in the cities in order to adapt to the demands of the population.

In order to cope with this situation, cities need to build new structures appropriate for the demands of the community, to guarantee the access to essential services, to provide an efficient transportation and waste management system, to shift to an inclusive policy and to deal with environmental and social concerns.¹⁸³

In recent times, ICT system has evolved and it has become a fundamental information and communication system able to connect people and to transfer data and information very smartly. Technology can solve problems related to the management of the city and to the environment, thus ICT operates in different contexts, from the private sector to the public one, creating added value.¹⁸⁴

The concept of smart city developed recently and it involves a series of actors and activities. Technology has a fundamental role, because it is used in order to improve the system, but it is not the only factor. The smart city is not only digital (it developed later than the digital city, which has its origins in the ‘90s and its aim is to spread information and connect people through technology, namely internet, hence improving living standards through ICT)¹⁸⁵, but it is the place where traditional networks and services are improved more efficiently through digital means. Thus, the smart city goes beyond the

¹⁸² San Francisco Ecocity Declaration. (2008, May 15). *Ecocity Media (blog)*. Retrieved from: <https://ecocity.wordpress.com/2008/05/15/san-francisco-ecocity-declaration/>

¹⁸³ Berloco, M. (2014/2015). Smart Cities: Green Economy, Innovazione e Sostenibilità nelle città del futuro, op. cit., p. 20

¹⁸⁴ Ivi, p. 21

¹⁸⁵ Cocchia, A., Dameri, R. P. (2013, December 14). Smart and Digital city: twenty years of terminology evolution, *ItAIS 2013, X Conference of the Italian Chapter of AIS*, Milan, pp. 1-8. Retrieved from: <http://www.itais.org/proceedings/itais2013/pdf/119.pdf>

mere concept of digitalisation, including the creation of smarter urban transport networks, smarter water supply and waste management systems, efficient electricity systems and an integrative policy, with the goal of improving people's quality of life and security.¹⁸⁶

Therefore, the smart city is connected to the green city; they are complementary, in the sense that a smart city is created through a variety of components of the green city, such as an efficient and smart system for reducing pollution, and a green city can be smart in promoting efficiency using technology, such as building an efficient resource management system. Indeed, the real notion of smart city is determined by a number of aspects connected with sustainability, creativity, innovation, social inclusion and cultural, economic and political development.¹⁸⁷ Actually, according to the scholar Francesco Gonella, the smart city concept is a key factor for sustainable urban communities' policy planning. It is also a useful narrative for urban marketing, to attract investment and to give the idea of a dynamic community and city.¹⁸⁸

There are various approaches to the smart city literature, which depend on the context in which scholars live. But, in line with all of the different methods, there is one element shared by the literature: the application of ICT to the infrastructural system.¹⁸⁹ In accord with the European Union, which stresses the fact that smartness and sustainability are the key issues of urban policy, the smart city is "a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and business".¹⁹⁰ According to Gonella, the smart city narrative is divided into two groups: the first one comprehends interconnectedness, ICT, e-Gov, data access, competitiveness, innovation, creative business, entrepreneurship and smart mobility, while the second one includes safety, health, smart living, cultural vibrancy, environmental sustainability and happiness.

¹⁸⁶ European Commission. What are smart cities? In Smart Cities. Cities using technological solutions to improve the management and efficiency of the urban environment, *European Commission*.

Retrieved from: https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en#what-are-smart-cities

¹⁸⁷ Berloco, M. (2014/2015). Smart Cities: Green Economy, Innovazione e Sostenibilità nelle città del futuro, op. cit., pp. 23-24

¹⁸⁸ Gonella, F. (2019, December 20). The Smart Narrative of a Smart City, In Urban Resource Management, *Frontiers in Sustainable Cities*, 1:9, p. 1

¹⁸⁹ Ibid

¹⁹⁰ European Commission. What are smart cities? Op. cit.

Actually, the two groups are interrelated, but this may be true only for specific targets of citizens. Indeed, Gonella asserts that in the smart city literature real problems, such as poverty, inequality and unemployment, which are at the basis of the un-smartness of a city, are not addressed at all. Thus, the smart city discourse leads to cognitive dissonance, talking about ephemeral cities that do not exist.¹⁹¹ Gonella reports the example of London. If we consider the degree of ICT interconnectedness, smart infrastructures, creative business and cultural vibrancy, London is one of the smartest cities in the world, according to the main institutions that deal with international rankings.¹⁹² But, in conformity with the official London Datastore, the level of poverty is still very high.¹⁹³

Thus, critics against the concept of smart city are increasingly common. Gonella says that the only way to pursue the smartness and the sustainability of a city is to use integrated systemic approaches in order to consider how all the elements of the complex city are interconnected through the urban structural network. Actually, as stated by the scholar, the application of systemic approaches and systemic awareness are lacking.¹⁹⁴

2.3 Benefits and limits

On the one hand, there are a number of benefits a green city can bring. These comprehend:

- efficient land-use;
- energy efficiency;
- efficient transport management system;
- efficient use of resources;
- waste-management system;
- low-carbon system;
- better living standards.¹⁹⁵

¹⁹¹ Gonella, F. (2019, December 20). The Smart Narrative of a Smart City, op. cit., p. 2

¹⁹² Eden Strategy Institute & OXD (ONG&ONG Experience Design). (2018/2019). Retrieved from: <https://www.smartcitiesworld.net/news/news/report-ranks-top-50-smart-cities-on-leadership-and-governance-3100>. See also IESE Business School's Centre for Globalisation and Strategy. (2019). Retrieved from: <https://www.smartcity.press/top-10-smart-cities-of-2019/>.

¹⁹³ London Datastore. Retrieved from: <https://data.london.gov.uk>

¹⁹⁴ Gonella, F. (2019, December 20). The Smart Narrative of a Smart City, op. cit., p. 5

¹⁹⁵ Sarkar, A. N. (2016). Eco-innovations in Designing Eco-cities and Eco-towns, op. cit.

Nowadays, the ever-increasing urbanisation process leads to changes in urban land-use and construction in order to provide people with better living conditions and to conserve natural resources. Indeed, the green city management system is designed to provide the restoration and preservation of the ecosystem.¹⁹⁶ According to the Green City Network, a green city's urban regeneration process should involve stopping soil consumption and strengthening soil protection in order to reduce the artificial cover and, instead, reuse or use efficiently the build-up area. Moreover, the network stresses the fact that a green city must adopt measures for climate mitigation in order to reduce the impact of GHG emissions, and for climate adaptation in order to cope with the already existing impacts of climate change. Last but not least, green cities improve the urban quality, which means protecting the society and improving the general wealth of the surrounding area, and they focus on green buildings and green infrastructures construction.¹⁹⁷

Furthermore, other benefits involve energy efficiency; hence, the reduction of primary energy through energy savings mechanisms, as well as the creation of efficient infrastructures, resource efficiency, which is perhaps the most challenging benefit since cities today are facing the problem of meeting the increasing primary resources' demand, a waste-management system capable of transforming waste into a fundamental resource and a low-carbon mechanism for reducing GHG emissions. Overall, the most rewarding benefit is the one of ensuring a high quality of life for the population which lives in the city.¹⁹⁸

On the other hand, there are also some drawbacks linked to green cities.

First of all, it is worth mentioning the three pillars of a sustainable city: economic development, environmental protection, and equity, social justice. The first pillar is related to the economic dimension. It means that sustainable development programs and policies should aim to realise economic growth and efficiency. The term efficiency basically refers to decoupling, in other words to get the same with less resources, to get more with same resources, to reduce waste. Another concept dealing with efficiency is

¹⁹⁶ Ibid

¹⁹⁷ Green City Network. (2020). Charter for the green city urban regeneration. To get out of the crisis, after the pandemic, with more care for our future, *Fondazione Sviluppo Sostenibile*. Retrieved from: <https://www.fondazionevilupposostenibile.org/wp-content/uploads/CHARTER-FOR-THE-GREEN-CITY-URBAN-REGENERATION.pdf>

¹⁹⁸ Sarkar, A. N. (2016). *Eco-innovations in Designing Eco-cities and Eco-towns*, op. cit.

the one of circular economy abovementioned. The second pillar refers to the protection of our ecosystem. It means to respect and to protect biodiversity and to preserve ecosystem services, that is the capacity of the ecosystem to sustain the different uses of land, water, etc. The third pillar includes society. That is to say that sustainable development should focus on concepts such as social inclusion, equity, participation of people in order to make the values explicit, to pay attention on the local dimension and therefore to respect cultural diversity.¹⁹⁹ Some authors focus on a fourth pillar: sustainable governance. It means to promote integration between different policies, or rather economic policies, social policies and environmental policies should be integrated to one another. Sustainable governance also means to address the issue of building capacity, that means to provide the condition for local and regional communities to define goals, resources and tools in order to attain these goals.²⁰⁰ This is the case of Singapore city-state's governance. C. Camarda and G. Macca, co-founders of Ethics4growth, a company that helps enterprises, startups and individuals to be profitable in a way that is ethical and sustainable for the environment, have defined these three pillars the so-called "3 Ps": profit, planet, people (Social Pillar). "We do not have a Planet B. We must take care of our environment", they stated.²⁰¹

Italian researcher Valeria Saiu identified a theory-practice gap in the shape of "the three pitfalls of a sustainable city", instead of the "three pillars", which risk is creating economic, cultural and social conflicts.²⁰² The three pitfalls are: the idea of the city as a business (business city), the oversimplification of urban complexity (simple city), and the quest for the ideal community (ideal city).²⁰³

Going further into detail, concerning the first drawback, the idea of the city as a business, green city projects are dependent on innovative technologies available on the market, thus the city is considered as an economic affair. However, this dependency is

¹⁹⁹ Campbell, S. (1996). *Green Cities, Growing Cities, Just Cities? Urban Planning and the Contradictions of Sustainable Development*, op. cit., p. 298

²⁰⁰ Blewitt, J. (2018). *Understanding Sustainable Development*, op. cit., pp. 151-153

²⁰¹ Camarda, C. & Macca, G. (2021, December 2). Sustainability is not a label! It's about mindset and process, In *Public Communication(s) in Europe*, Bruxelles: Belgian State – Chancellery of the Prime Minister, Club of Venice 35 years, p. 166

²⁰² Saiu, V. (2017, December 15). *The Three Pitfalls of Sustainable City: A Conceptual Framework for Evaluating the Theory-Practice Gap*, op. cit., pp. 1-2

²⁰³ Ivi, p. 4

disadvantageous for the poorest part of the population, because green technologies are very expensive and the investment rate is very high. Hence, there is a gap between the richest and the poorest.²⁰⁴ For what concerns the second drawback, the oversimplification of urban complexity, technologies involved in the creation of the green city are considered the only solution to a number of problems. Indeed, the discourse is techno-centred and limited to energy systems, building efficiency and transportation. Nevertheless, sustainable development of a city implies, first of all, the integration of the community and the collaborative efforts of the population, and, in addition, the technology needed in order to build an efficient and green city. Hence, technology is not only the simple solution in order to build a sustainable city, but there are other important elements to consider. Finally, the third drawback, the quest for the ideal community, is connected to the first one. Indeed, the eco-city project entails a variety of green proposals able to integrate societies and to increase living standards of the population, but this aim is often achieved only in theory. The reason is that the cost of green technology is very high, thus the green city could be an ideal community only for the wealthiest part of the population.²⁰⁵

2.4 Cities' commitment to climate change

Green cities have a lot of benefits, but, as mentioned above, they also have some shadows. In order to achieve sustainability in cities and to set emission reduction goals, cities should commit together to cope with this problem. More than 2400 companies, cities, regions and investors have already committed to do so.²⁰⁶

One example of commitment is the so-called NAZCA. It was launched in Peru in December 2014, and it developed thanks to the support of the UNFCCC. Its main goal is to present commitments by cities, regions, companies and investors. Leading action on NAZCA is supervised by the Lima-Paris Action Agenda (LPAA) initiatives, which are accelerating ambition. The aim of LPAA is the one of encouraging entities to act now by

²⁰⁴ For further details about the gap between the richest and the poorest, see Singer, M. (2018). *Climate Change and Social Inequality: The Health and Social Costs of Global Warming*, op. cit., Chapter I, 1.3

²⁰⁵ Saiu, V. (2017, December 15). The Three Pitfalls of Sustainable City: A Conceptual Framework for Evaluating the Theory-Practice Gap, op. cit., pp. 6-8

²⁰⁶ Global Climate Action NAZCA. Retrieved from: <http://climateaction.unfccc.int>

joining their initiatives. Both the LPAA and NAZCA were launched in Lima at COP20 and, together, they supported a universal climate agreement at COP21 in Paris.²⁰⁷

Cities, local and sub-national governmental organisations have become active participants in international climate change negotiation processes and in advocating climate action. Some of the most important treaties, pacts, declarations and compacts are the following:

- the SCP was launched in the early 1990s by two key bodies, the UN-Habitat and the UNEP. It is a programme which seeks to implement and improve urban environmental planning and management. The first phase of SCP concluded in 2001, while the second phase came to an end in 2007. Its targets are local and national authorities; indeed, it promotes good environmental governance in order to encourage local and national partners to adopt Environmental Planning Management (EPM)²⁰⁸ processes. SCP applied Agenda 21 principles, and it operated with its sister programme, Localising Agenda 21 (LA21), in more than 30 countries worldwide;²⁰⁹
- the Global Cities Covenant on Climate – the Mexico City Pact was established in 2010 and its aim was to set a series of voluntary commitments for mitigation and adaptation measures. Indeed, it registered all commitments, actions, inventories and measures. Signatories also cooperated in order to find ways to enhance funding for local climate actions;²¹⁰

²⁰⁷ Ibid

²⁰⁸ EPM is a strategy used in order to solve problems affecting the environment in the contemporary world

²⁰⁹ Fook, L. L., Hofmeister, W. & Rueppel, P. (2014). *Eco-Cities: Sharing European and Asian Best Practices and Experiences*, EU-Asia Dialogue. Shaping a Common Future for Europe and Asia – Sharing Policy Innovation and Best Practices in Addressing Common Challenges, Singapore: National Library Board, pp. 10-11. See also Sustainable Cities Programme (SCP). Retrieved from: https://www.fukuoka.unhabitat.org/programmes/detail04_03_en.html. See also Localizing Agenda 21 (LA21). Retrieved from: <https://mirror.unhabitat.org/content.asp?typeid=19&catid=540&cid=5023>

²¹⁰ United Nations Climate Change (UNCC): e-Learn. Commitments by cities and local governments on climate change, op. cit. See also Global Covenant of Mayors. Retrieved from: <https://www.globalcovenantofmayors.org>

- the Durban Adaptation Charter was launched at the UNFCCC COP17 in Durban in 2011 and it has over 1000 signatories. In this chart, local governments committed to local climate action in order to adapt to climate change risks;²¹¹
- the Nantes Declaration of Mayors and Subnational Leaders on Climate Change was signed in 2013. It committed to advocate for a new global climate change regime;²¹²
- the World Summit Climate & Territories Declaration of 2015 is one of the most widely followed climate declarations. It is signed by 50 networks of subnational and local governments, as well as social organisations. It represents over two-thirds of the world population. Other than acting against climate change disasters, signatories committed to call for greater access to financial resources for local and subnational governments in order to address climate change;²¹³
- the Compact of Mayors, or the Global Covenant of Mayors for Climate & Energy, was launched in 2014 by the ex-UN Secretary-General Ban Ki-moon and the UN Special Envoy for Cities and Climate Change, Michael R. Bloomberg at the Climate Summit that year. The founding fathers of the Compact of Mayors are major city networks, Local Governments for Sustainability (ICLEI), United Cities and Local Governments (UCLG), and the C40 Cities Climate Leadership Group, supported by the UN-Habitat. Furthermore, there are also other partners that contributed to the creation of the compact, such as the World Wildlife Fund (WWF) and the World Resources Institute. The Compact of Mayors is the world's largest coalition of city leaders which aim is to act in order to work towards a resilient and low-carbon emission society.²¹⁴

2.5 Green cities around the world: future cities

Green cities, and the respect for the environment, will become far more important over the next decades, since the transition to green and sustainable cities is considered a way to use resources more efficiently, thus spurring economic growth rate.²¹⁵

²¹¹ Ibid

²¹² Ibid

²¹³ Ibid

²¹⁴ Ibid

²¹⁵ Asian Development Bank (ADB). (2012, November). *Green Cities*, op. cit., p. 406

According to an analysis carried out by Resonance Consultancy²¹⁶, a leading advisor on branding, marketing and placemaking, greenest cities represent the key for our future. In order to create an index of the world's greenest cities, Resonance examined the 50 most visited cities of the world (based on the total number of Tripadvisor reviews). The analysis is based on a number of "green criteria", namely the percentage of public green spaces, the percentage of renewable energy needs, the percentage of population who use public transports to go to work, the level of polluted air, per capita water consumption, walkability, availability of recycling methods, availability of composting methods and the quantity of farmer's markets.²¹⁷

According to Resonance's analysis, the world's 10 greenest cities in 2021 are:

- 1- Vienna, Austria (it has a number of green spaces and public transport is frequently used);
- 2- Munich, Germany (it is walkable and it has an impressive transport system, such as the U-Bahn, the Munich underground rapid transport system);
- 3- Berlin, Germany (it is walkable, there are a variety of parks and open spaces and it almost has the lowest rate of per-capita water consumption in Europe);
- 4- Madrid, Spain (it has an abundance of green spaces and it is very practicable);
- 5- São Paulo, Brazil (it has a great quantity of farmers' markets and its population, overall, is considered to be the largest user of renewable energy in the world);
- 6- Manchester, United Kingdom (it is very walkable, it has several agricultural markets and it has a high level of public transport usage);
- 7- Lisbon, Portugal (it has some agricultural markets, but it is particularly interesting for its recycling and composting systems);
- 8- Singapore, Singapore (it has plenty of green spaces, such as the Gardens by the Bay project, and the government is aiming at transforming parks into therapeutic gardens for the most vulnerable);
- 9- Amsterdam, Netherlands (it is famous for the number of cyclists it has, but it is also well-structured for pedestrians);

²¹⁶ Resonance Consultancy Website. Retrieved from: <https://resonanceco.com>

²¹⁷ Fair, C. (2020, April 22). The World's Greenest Cities are our future, op. cit.

10- Washington D.C., United States (it has a number of parks and green oasis, and there are also some farmers' markets).²¹⁸

Hence, these cities are well-designed and well-structured in order to increase people's living standards.

The National Geographic magazine conducted a research on the cities of the future, asking to some experts of Skidmore, Owings & Merrill (SOM), a famous urban planning, architectural and engineering firm, which are the characteristics of a city of the future. Their vision encompasses ecology, economy, natural resources, infrastructures and culture.²¹⁹

According to SOM experts' advices, the city of the future must be as follows: concerning urban hubs, they must comprehend a system of rainwater cleansing (e.g. bioswales²²⁰), green roofs, urban farming mechanisms and advanced transport systems (e.g. regional high-speed rail stations); smart buildings represent another fundamental feature of green future cities, in that they are composed of sky gardens, solar walls and windows able to capture Sun's energy, in addition to green streets around them; social interiors are also important, indeed, shared spaces for all increase interactions and social equity, and green spaces inside buildings improve air quality; to conclude, self-contained neighbourhoods are designed in order to meet people's needs in a short period of time, using drones as a new way of transport, for example.²²¹

2.6 Globalisation of green vision: taking the Asian example

As noted in the first chapter, the majority of the population growth expected in urban areas (urbanisation) will be concentrated for the most part in developing countries, in

²¹⁸ Earth.org. (2021, May 17). The World's 10 Greenest Cities in 2021, *Earth.org*. Retrieved from: <https://earth.org/the-worlds-greenest-cities-in-2021/>

²¹⁹ National Geographic. From Mega-Regions to Micro-Size Homes: Cities of The Future, In The Cities Issue, *National Geographic*. Retrieved from: <https://www.nationalgeographic.com/magazine/graphics/see-sustainable-future-city-designed-for-people-and-nature>

²²⁰ Bioswales are gardens which absorb rain and filter it for reuse

²²¹ National Geographic. From Mega-Regions to Micro-Size Homes: Cities of The Future, op. cit.

particular Africa and Asia, rather than developed ones.²²² For this reason, Africa and Asia must pay particular attention on the growth of their cities, considering economic growth, but also environmental and social concerns. One way to meet this goal is to create eco-cities, and some Asia's regions are doing it very well. For example, growing cities in the East Asia and Pacific (EAP) region are so important that will define the region's energy future and its GHG footprint.²²³ The rapid urbanisation process of the 21st century and the related growing standards of living are pushing some EAP cities to become important cases of green growth, primarily adopting energy efficient solutions in order to minimise the use of primary energy. The urban system which needs to be as efficient as possible is the infrastructural one, as it is the driver of the city. Hence, it is necessary to avoid locking cities in energy-intensive infrastructures.²²⁴

Even if it is difficult to implement sustainable systems in the cities, since energy efficiency and low-carbon policies require city governments to reform their institutions, to build capacity and to strengthen energy planning and energy governance, three cities of Southeast Asia, namely Cebu City (the Philippines), Da Nang (Vietnam) and Surabaya (Indonesia), are strongly committed to implement green urban policies development.²²⁵

Actually, one of the possible and few solutions comprehends the formation of alliances and collaboration between city governments at the local and national level, but also between civil society and the private sector, corporations in particular, because they contribute to the advancement of the green economy of the city.²²⁶

The water sector is the one who faces major challenges in Southeast Asia, due to high leakage rates, improper infrastructure and low efficiency awareness. Indeed, some EAP cities are implementing efficiency awareness campaigns through the development of green growth processes.²²⁷

²²² United Nations Department of Economic and Social Affairs (UNDESA). (2014). World Urbanisation Prospects: The 2014 Revision, UNDESA, p.1. Retrieved from: <https://population.un.org/wup/Publications/Files/WUP2014-Report.pdf>

²²³ Ostojic, D. R., Bose, R. K., Krambeck, H., Lim, J. & Zhang, Y. (2013). *Energizing Green Cities in Southeast Asia: Applying Sustainable Urban Energy and Emissions Planning*, Washington, DC: World Bank, p. 1

²²⁴ Ibid

²²⁵ Ibid

²²⁶ Ibid

²²⁷ Ivi, pp. 14-15

Going back to the topic of urbanisation, in India and China, the biggest Asian countries, national and local authorities have to cope with the migration of the population from rural areas to the city centres. Obviously, this has given rise to mega-cities, as also stated in the first chapter, capable of containing such large amount of people. One solution some Asian cities have found in order to overcome the problem of rapid urbanisation process is to build up high-density eco-friendly cities.²²⁸

Countries like Japan and South Korea (ROK) have built a vast number of sustainable cities and, actually, they are continuing to do so.²²⁹

Singapore is another example of green transformation. The city-state started to include the green agenda into its planning immediately after its independence in 1965, combining urban living with nature and the environment.²³⁰ Amongst the very first initiatives to transform Singapore into a Garden City, in 1963 Lee Kuan Yew, then Prime Minister (PM), launched the first “Tree Planting” campaign in order to provide the city-state with greenery and shade. Later on, in 1967, the “Garden City” campaign followed and, in 1971, the campaigns culminated in the first “Tree Planting Day”, now an annual tradition of Singapore.²³¹ Singapore may seem an improbable applicant for green planning due to its rapid industrialisation and the presence of few natural resources in it, but it took advantage of this situation in order to adopt, in 1992, an environmental programme entitled “The Singapore Green Plan” (SGP2012).²³² As it will be described in the following chapter, this tiny city-state of South-East Asia is truly a model for Green Plans. It has inspired many countries, in particular China, which share with it the same concerns in the shape of population density, air and water pollution, waste management, transportation, public health, etc.²³³

²²⁸ Fook, L. L., Hofmeister, W. & Rueppel, P. (2014). *Eco-Cities: Sharing European and Asian Best Practices and Experiences*, op. cit., p. 13

²²⁹ Ibid

²³⁰ De Ferrer, M. (2020, October 11). How has Singapore learned to blend nature with urban living? In Green News, *Euronews.green*. Retrieved from: <https://www.euronews.com/green/2020/11/10/how-has-singapore-learned-to-blend-nature-with-urban-living>

²³¹ Singapore National Parks Website. 1963: The Greening of Singapore, In Singapore Botanic Gardens, *Singapore National Parks*. Retrieved from: <https://www.nparks.gov.sg/sbg/about/our-history/1963-the-greening-of-singapore>

²³² Johnson, H. D. (2008). *Green Plans: blueprint for a sustainable earth*, op. cit., pp. 155-156

²³³ Ivi, p. 161

According to P. Khanna, Asia is becoming a global superpower. First of all, geographically speaking, Asia extends from the Mediterranean Sea and the Red Sea to the Pacific Ocean, incorporating two-thirds of the Eurasian continent and comprehending 53 countries.²³⁴ The “Asian century”, as asserted by the geographer and global strategist, has already begun. He clearly says: “When in 2100 we will think back to the year in which the cornerstone of a new world order with Asian traction was led, it will be 2017”.²³⁵ In May, that year, 68 countries (two-thirds of the global population and half of world GDP) reunited at Beijing for the First Summit of the Belt and Road Initiative (BRI). At that occasion, Asian, European and African leaders inaugurated symbolically the launch of the biggest coordinated plan of infrastructural investments of the human history. Governments which were present at the meeting have committed to spend collectively thousands of billions of dollars in the years ahead in order to connect the major urban centres of the world in a network of trade and cultural interchanges. This is a new Silk Road. BRI is the most significant project of the 21st century in terms of trade and diplomacy, the equivalent of what the creation of the UN, the World Bank and the Marshall Plan have represented for the 20th century. The only difference is that the BRI has been created by Asia and it will be guided by Asian people.²³⁶

The Asian Economic Zone, which from the Arabic Peninsula and Turkey in the West arrives to Japan and New Zealand in the East, represents the 50% of the global GDP and two-thirds of the global economic growth.²³⁷

An Asian way of doing things is expanding more and more. Officials, businessmen, scholars and students from the West are admiring how Asia is constructing huge global infrastructures and futuristic cities. The title of the flagship online magazine of the Singaporean Lee Kuan Yew School of Public Policy reflects the transition towards a new paradigm: Global-is-Asian.²³⁸

²³⁴ Khanna, P. (2019). *Il secolo Asiatico?* Op. cit., p. 11

²³⁵ Ivi, p. 12 (translation by the author)

²³⁶ Ibid

²³⁷ Ivi, p. 15. See also Asian Development Bank (ADB). (2015). *Key Indicators for Asia and The Pacific 2015*, Mandaluyong City, Philippines: Asian Development Bank (ADB), XXXXVI Ed., pp. 272-279

²³⁸ Global-is-Asian. Singaporean Lee Kuan Yew School of Public Policy. Retrieved from: <https://lkyspp.nus.edu.sg/gia>

Moreover, according to Khanna, Western countries are considering the idea of embracing technocratic forms of governance, as like Asian countries are doing. This derives from an Asian predisposition to political pragmatism and to an innate fear of lack of mass discipline. Indeed, global political discourse is shifting from democracy towards a different governmental field, in which the performance of a country is the new parameter for determining its success, including quality of governance and citizens' satisfaction, for example. All societies aspire to a balance between prosperity and livability, openness and protection, effective governance and democratic participation, individualism and cohesion, free choice and welfare. Common people don't measure these parameters through the level of democracy of a country, but through the level of security, stability and quality of living of their country. Asian forms of government have a long-term vision of collective benefits rather than concentrate on short-term hyper individualism and on individual interests.²³⁹ This is of interest to a number of English ministers and economists who, in the aftermath of Brexit, have expressed their hope that the United Kingdom will become the "European Singapore". As Professor Khanna has stated, it could seem ironic that United Kingdom is taking examples from its former colony, but Singapore, the most famous technocracy of Asia, has a lot to share with the world.²⁴⁰

Last but not least, the technocratic form of government is also meritocratic, because it rewards competent leaders, and utilitarian, because it aspires to social welfare in a broad term.²⁴¹

Thus, green innovations, green urbanism and an efficient technocratic governance in Asia represent a challenge that must make Western governments and societies reflect, because of its effectiveness. Asian cities, the economic growth engine of the globe, suggest that a green and smart future is possible if eco-friendly and eco-efficient measures are implemented.²⁴²

²³⁹ Khanna, P. (2019). *Il secolo Asiatico?* Op. cit., p. 405

²⁴⁰ Ivi, p. 406

²⁴¹ Ibid

²⁴² Matan, A., Newman, P. (2013). *Green Urbanism in Asia: The Emerging Green Tigers*, Singapore: World Scientific Publishing, p. vii

CHAPTER III

Case study: Singapore as a green city-state

Asia is one of the leading countries concerning the design of innovative and green cities. As asserted in the second chapter, urbanisation and its related problems are pushing the EAP region to adopt green and sustainable cities in order to transform its cities into climate resilient and liveable ones.

Singapore, a small Southeast Asian city-state, has the primacy in this, and actually it represents an example to follow for neighbouring and beyond-the-region cities and countries. The following pages will account for the reason why Singapore has been selected as the case study of this work.

Probably, the fundamental reason why Singapore developed in this way is represented by its precarious condition as a small island lying in a vulnerable transshipment area in front of the Strait of Malacca. It is vulnerable to piracy, external economic and financial shutdowns and global crisis of various origins. Thus, Singapore had to develop in a smart and green way in order to survive global shocks, in particular climate change. This is its major strength. Another point is Singapore's leadership. The potential of this tiny city-state comes from its technocratic leadership, from Lee Kuan Yew to its successor Goh Chok Tong to Lee's son, Lee Hsien Loong. Their perseverance, together with their dynamic and innovative attitude, brought the country towards success. Actually, Lee Hsien Loong is continually striving for rendering Singapore a leading city-state for what concerns sustainability, in order to meet UN's SDGs 2030. Being internationally recognised, also by leading global powers such as the United States, Singapore's talent and expertise have been exported to the world, defining Singapore as a global hub.²⁴³

This chapter aims at introducing Singapore, examining in detail its strengths and vulnerabilities, followed by its history from English colonialism to independence until being considered the greenest city-state of Asia. Hence, an historical overview is needed in order to explain why and how it achieved the title of "Garden City" at last. Furthermore, green buildings in Singapore will be introduced, and two main green buildings will be further analysed, namely Nanyang Technological University Singapore and Khoo Tech

²⁴³ Calder, K. E. (2016). *Singapore: Smart City Smart State*, Washington, D.C.: Brookings Institution Press, p. 19-21

Puat Hospital, two important areas which combine quality of life and respect for the environment with supply of smart facilities for the population. Another important point will be pointed out: the analysis of Singapore as a smart city-state, in addition to its green dimension. This includes a variety of spheres, from smart policy and governance, to smart technological innovations and smart people, to smart urban planning and economy. Finally, since Singapore represents a model worldwide, in particular for developing countries, China has a lot to learn from it. Indeed, in the 1980s, a tight alliance between Chinese and Singaporean governments began, and it resulted in the so-called Sino-Singapore partnership.²⁴⁴ To this end, the Sino-Singapore Tianjin Eco-City project will be analysed in order to raise awareness of the Chinese interest towards the Singaporean model. Nevertheless, eco-city projects in China are often only a theoretical ambition, because smartness and greenery start from the community's commitment that sometimes lacks in China, even though the Singaporean partnership is exporting its model very well.

²⁴⁴ Ivi, p. 151

3.1 Singapore and a world of change: strengths and vulnerabilities

Nowadays, one of the most challenging matters in the today's rapidly changing world is the problem of governance. This concern depends on finding governmental structures that can cope with the increasingly complex problems faced by the community everywhere. The problem of governance is especially transparent in huge developing countries like China, India and Indonesia.²⁴⁵

Speculation has arisen on what form of governance should be the right one for the 21st century. According to the scholar K. Calder, there is consensus that the ideal future structure of governance should not reflect the conventional welfare state. Indeed, a new concept has emerged, the so-called "virtual state" of minimal geographic or political-military entity which nevertheless is very important for disseminating knowledge.²⁴⁶

Global problems, such as climate change and related subjects, have been tackled both at the national and international levels, but little progress has been met. For this reason, cities are considered the focus for solving this problem, even more than nations, because they tend to be more focused on everyday problems. For example, the C40 group has already addressed a number of global environmental challenges, while the COP series of debates have made less concrete progress.²⁴⁷

In today's turbulent and volatile world, one city, more specifically a city-state, which offers fundamental lessons in the field of governance is Singapore. It is special since it has two levels of governance: it is a nation-state (one of the 193 UN members), so it possesses the legitimacy, the autonomy and the resources that enable it to act on the global scale, and it is also a city, very tiny in size, but which hosts almost 6 million inhabitants. Singapore is part of the more than 1000 cities worldwide having more than 500.000

²⁴⁵ Micklethwait, J. & Wooldridge, A. (2015). *The Fourth Revolution: The Global Race to Reinvent the State*, Penguin Books Ltd, pp. 105-168. See also Calder, K. E. (2016). *Singapore: Smart City Smart State*, Washington, D.C.: Brookings Institution Press, p. 2

²⁴⁶ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 2. See also Rosecrance, R. (1999). *The Rise of the Virtual State: Wealth and Power in the Coming Century*, New York: Basic Books

²⁴⁷ Ibid. See also Barber, B. (2013). *If Mayors Ruled The World: Dysfunctional Nations, Rising Cities*, Yale University Press

people inhabiting them, which together house over one-third of the world's population and whose number is predicted to increase to 1400 in 2030.²⁴⁸

Thus, Singapore has two dimensions: it is both a city and a state. On the international scene, being both a city and a state is a source of strength. This tiny city-state is smart and adaptive in the today's volatile global world, and it achieved these characteristics since it had the necessity to act smartly in order to face the difficulties that a small-scale nation usually faces.²⁴⁹ Indeed, Singapore's success in public policy management and international affairs is confronted with a geographical paradox: it is one of the smallest and most vulnerable countries on Earth. First of all, it is very small in size, covering about 700 square kilometres, while population density is high. According to the latest statistics of the Department of Statistics of Singapore, population density per km² has increased until reaching 7485 people.²⁵⁰ Furthermore, Singapore lacks of natural resources. It has no domestic oil and gas, and despite its tropical weather, it is short of water, having to import it from Malaysia. Moreover, despite its substantial amount of population, it lacks of locally developed human resources. According to the Strategy Group Prime Minister's Office, National Population and Talent Division, in 2015, 21% of Singapore's white-collar workers were of foreign nationality, while blue-collar workers were in short supply, meaning that the majority of the total employment rate came from the guest workers.²⁵¹ Nowadays, in 2021, Singapore's citizens are 3,50 million, while its non-residents are 1,47 million. Foreign employment in Singapore has decreased due to travel restrictions and uncertain economic conditions because of Covid-19 pandemic, but the percentage of non-residents in the city-state remains high.²⁵² Hence, a large number of Singapore's local labour force is foreign, thus generating a discontent between the population. The domestic

²⁴⁸ United Nations Department of Economic and Social Affairs (UNDESA). (2014). *World Urbanisation Prospects: The 2014 Revision*, op. cit., pp. 474-493. See also Calder, K. E. (2016). *Singapore: Smart City Smart State*, Washington, D.C.: Brookings Institution Press, p. 3

²⁴⁹ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., pp. 2-18

²⁵⁰ Department of Statistics – Singapore. Retrieved from: <https://www.singstat.gov.sg/whats-new/latest-data>

²⁵¹ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 18. See also Strategy Group Prime Minister's Office Singapore. (2012, July 26). *Our Population Our Future: Issues Paper July 2012*, p. 31. Retrieved from: <https://www.strategygroup.gov.sg/media-centre/publications/our-population-our-future>

²⁵² Strategy Group Prime Minister's Office Singapore, National Population and Talent Division. Retrieved from: <https://www.population.gov.sg/our-population/population-trends/overview>

labour shortage could be a vulnerability for Singapore, but, in reality, Singapore sees this shortage as a challenge to innovation and improvement.²⁵³

Recently, Singapore PM Lee Hsien Loong affirmed: “We need to continue to welcome foreign talent, while encouraging employers to train and build up the local talent pool”.²⁵⁴ This statement highlights the fact that Singapore intends to transform its vulnerabilities, in this case the labour-shortage, into competitive strengths in a world based on competition transnationally.

Another vulnerability of Singapore is related to its geopolitical circumstances. The city-state lies between three of the most important developing countries on Earth: China, India and Indonesia, all of them predicted to be three of the major powers in the 21st century.²⁵⁵ Moreover, it is located in front of the Strait of Malacca, arguably the most important maritime point for economic and military exchanges. The fact that Singapore lies astride the strait poses serious difficulties to its security, since the major oil and gas producers of the world, hence, the ones of the Persian Gulf and the growing economies of Asia, pass through that strait every day. This imply that this tiny city-state is a target for terrorists and pirates who want to take global control. Three types of piracy groups typically attack Southeast Asia: small criminals, well-organised criminal gangs and armed separatists.²⁵⁶ To this problem, it also adds the fact that Singapore’s neighbourhood in Southeast Asia has always been unstable, generating further national-security challenges for the city-state.²⁵⁷

Furthermore, Singapore’s geo-economic scenario is a double-edge sword. It has a strategic location, since its neighbours, three of the major powers of the world – China, India and Indonesia – have an interest in it. These three powers all have important

²⁵³ Ibid

²⁵⁴ Prime Minister’s Office Singapore. (2012, September 29). Speech by Prime Minister Lee Hsien Loong at the Singapore Manufacturers’ Federation 80th Anniversary Dinner. Retrieved from: <https://www.pmo.gov.sg/Newsroom/speech-prime-minister-lee-hsien-loong-singapore-manufacturers-federation-80th>

²⁵⁵ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 19

²⁵⁶ Ivi, pp. 19-21. On the challenge of piracy see also Ho, J. (2006, July-August). The security of sea lanes in Southeast Asia, 46:4, *Asian Survey*, pp. 561-562. On the challenge of terrorism, see also Tan, J. (2013, March 26). S’pore Still a Target for Terrorism: PM Lee, *Yahoo Newsroom*. Retrieved from: <https://sg.news.yahoo.com/s’pore-still-a-target-for-terrorism--pm-lee-065553326.html>

²⁵⁷ Ibid

economic forecasts, and Singapore as well, due to the mix of vulnerabilities and strengths given by its strategic placement.²⁵⁸

Even if it is a diminutive city-state located between important economic powers, its current account balance (% of GDP) is in surplus (17.6%), even during and after a pandemic crisis.²⁵⁹ However, in addition to economic improvements, Singapore has been badly affected by global economic recessions, for example, the Asian financial crisis of 1997-1998 and the Lehman crisis of 2008. Yet, it can also benefit from economic recoveries, such as during 2010-2014.²⁶⁰

Concerning finance and macroeconomy, Singapore has always ranked throughout its history as Number One in terms of openness to international trade and foreign investment.²⁶¹ The city state is a free port, with tariffs set at zero and total commodity trade amounting at 203.6% of GDP, exceeding national GDP.²⁶² Net inflows of foreign direct investment (FDI) equated 32.2% of GDP in 2019, leading to an increase since 2008 crisis, which amounted to 7% of GDP at that time.²⁶³

²⁵⁸ Ibid

²⁵⁹ Current account balance is the sum of net exports of goods and services, net primary income, and net secondary income. On the current account balance (% of GDP) of Singapore see The World Bank. (2020). World Development Indicators | DataBank, *The World Bank*. Retrieved from: <https://databank.worldbank.org/source/world-development-indicators>. Other sources are the International Monetary Fund, the Balance of Payments Statistics Yearbook and data files, and the OECD GDP estimates. Data are based on the sixth edition of the IMF's Balance of Payments Manual (BPM6) and are only available from 2005 onwards

²⁶⁰ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., pp. 22-23

²⁶¹ Ivi, p. 4. See also p. 22

²⁶² Merchandise trade as a share of GDP is the sum of merchandise exports and imports divided by the value of GDP, all in current US dollars. On the merchandise trade (% of GDP) of Singapore see The World Bank. (2020). World Development Indicators | DataBank, *The World Bank*. Retrieved from: <https://databank.worldbank.org/source/world-development-indicators>. Other sources: The World Trade Organisation

²⁶³ According to the OECDiLibrary, foreign direct investment (FDI) is a category of cross-border investment in which an investor resident in one country establishes a lasting management interest (10 percent or more of voting power) in an enterprise resident in another country. FDI represents an important element in international economy, since it creates stable and long-lasting links between economies. On FDI (% of GDP) of Singapore see The World Bank. (2019). World Development Indicators | DataBank, *The World Bank*. Retrieved from: <https://databank.worldbank.org/source/world-development-indicators>.

Singapore, as already seen, is one of the most open city-states in the world in terms of international trade, but it has also some shadows. Due to its high degree of openness, it is vulnerable to periodic and international economic shocks, such as the Asian financial crisis and the Lehman crisis abovementioned, to name but a few. Since the international economy is volatile, it can cause serious problems to Singapore's domestic parameters, including exchange rates, commodity prices, economic growth... One of the farthest-reaching consequences for Singapore is the appreciation in the exchange rate and real estate, which made Singapore the 7th most expensive city to live in 2021.²⁶⁴ Once again, given its vulnerabilities in terms of economy and finance, Singapore's city-state needed to be smart in order to manage the multiple challenges that were overcoming it.

Concerning politics, Singapore has a heritage of turbulent and volatile politics both at home and abroad. This depends on the fact that during Lee Kuan Yew's mandate, the first PM of Singapore, together with his "Old Guards" comrades, the political situation was unstable. They had to face four distinct political regimes even before Singapore's independence in 1965 (British colonial rule, Japanese occupation, limited self-government, unification with Malaysia), not to mention the challenges they encountered right after independence (difficulties of the Vietnam War, initiation of the Chinese Cultural Revolution with Mao Zedong, communist parties, ethnic nationalism...). Furthermore, at the beginning of 1970s, Britain withdrew its military forces from Singapore, leaving the city-state in an even more challenging situation for its national security due to the volatile condition of Southeast Asia. Not long thereafter, the political situation stabilised, but Singapore needed to be always "smart" in order to survive political uncertainties, as it did at the time of the Gulf War (1991), the Asian financial crisis (1997-98), the 9/11 terrorist attacks, the Lehman shock (2008) and the global oil-price collapse (2014-16).²⁶⁵

Other sources are the International Monetary Fund, the International Financial Statistics and Balance of Payments Databases, the International Debt Statistics, and the OECD GDP estimates. Data starting from 2005 are based on the sixth edition of the IMF's Balance of Payments Manual (BPM6)

²⁶⁴ Street, F. (2021, June 22). World's most expensive cities for expats in 2021 revealed, *CNN travel*. Retrieved from: <https://edition.cnn.com/travel/article/worlds-most-expensive-cities-expats-2021/index.html>

²⁶⁵ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., pp. 24-25

Singapore has the best and most efficient bureaucratic system on Earth, and, according to the Political and Economic Risk Consultancy, in 2018 it was the least corrupt city-state in Asia.²⁶⁶ In addition, Transparency International, the global coalition against corruption, has ranked Singapore number 3 out of 180 countries on Earth in 2020. It means that it is one of the cleanest places to do politics ever.²⁶⁷ Indeed, the rule of law has a much greater impact there than in any other neighbouring country. However, even if Singapore does have regular democratic elections, its policy approach is more severe regarding civil liberties and political rights than in Western democracies, for example. According to the Freedom House, in its Freedom in the World rankings 2021, Singapore ranks as a “partly free” city-state.²⁶⁸

Furthermore, Singapore is an expensive place to live in. According to a survey of The Economist Intelligence Unit, the city-state is ranked as number 4 in terms of costs of housing out of 133 cities worldwide in 2020. Fortunately, costs of living have decreased since 2015, when, at that time, Singapore was ranked as number 1.²⁶⁹ Anyway, the futuristic and green city is becoming an unequal society, due to its market-oriented vision and its high housing costs. According to Calder, Singapore Gini coefficient²⁷⁰ has

²⁶⁶ The Political and Economic Risk Consultancy. (2018). Annual Review of Corruption in Asia 2018, *Asian Intelligence*. Retrieved from: <http://www.asiarisk.com/subscribe/dataindx.html>

²⁶⁷ Transparency International. (2020). Corruption Perceptions Index 2020, *Transparency International*. Retrieved from: <https://www.transparency.org/en/cpi/2020/index/sgp>

²⁶⁸ Singapore is ranked 48/100 in the Freedom in the World Rankings of 2021 (political rights 19/40, civil liberties 29/60). Actually, Singapore has been ruled by the People’s Action Party (PAP) and by the family of current Prime Minister Lee Hsien Loong since 1959. PAP’s framework is favorable to political pluralism, but it is strongly against the growth of opposition parties, and it limits the freedom of expression, assembly and association. On the Freedom in the World Rankings of 2021 see Freedom House. (2021). Freedom in the World Rankings 2021 – Singapore, Freedom House. Retrieved from: <https://freedomhouse.org/country/singapore/freedom-world/2021>

²⁶⁹ The Economist. (2020, November 18). Where are the world’s most expensive cities? *The Economist*. Source: The Economist intelligence Unit. Retrieved from: <https://www.economist.com/graphic-detail/2020/11/18/where-are-the-worlds-most-expensive-cities>

²⁷⁰ Gini coefficient, which was developed by the statistician Corrado Gini, is a statistical measure of income inequality or wealth inequality within a country. It ranges from 0 to 1, where a coefficient of 0 indicates perfect equality, while a coefficient of 1 expresses 100% of inequality

continued to increase since 2000.²⁷¹ Nevertheless, it remains lower than in the United States.²⁷²

Singapore is also a leverage for its neighbouring states of the Association of Southeast Asia Nations (ASEAN), but also for other powers beyond the region, such as Japan, China and India. They share some common interests, such as political stability, indeed, according to Calder, Singapore is considered a powerful stake in system stability, both at regional and at global level, so much so that it is a catalyst for United States also. This foreign interest is dictated by Singapore's precarious circumstances and its consequent stimulus to act in an innovative and holistic way to crisis. Its adaptive capacity also depends on its embedded urban structural network, including a unicameral legislature, a functioning bureaucracy without rivalries and a holistic governmental approach. In addition, the innovative urban structural network of Singapore has interacted positively with the Digital Revolution, the so-called third wave of globalisation, and the Internet of Things (IoT), a new network infrastructure to control remotely physical objects through sensors. This has given more digital power to the city-state, enhancing information flow and transparency.²⁷³

3.2 The history of Singapore: from colonialism to independence to Asia's greenest city-state

Singapore has got a short but turbulent history behind itself. The growth of this city-state into one of the most prosperous cities of Asia is due to the establishment of British colonial rule during the 18th century, when Western countries started to trade in Southeast Asia.²⁷⁴

First of all, if we go back in time, the first news about Singapore date back to the 3rd century, according to the witness of some Chinese accounting books.²⁷⁵ The texts talk about Singapore as *Pu-Luo-Chung*, translated into English language as the "Island at the

²⁷¹ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 12

²⁷² Ibid

²⁷³ Ivi, pp. 25-27

²⁷⁴ Hassan, R. (1969). Population change and urbanisation in Singapore, In *Civilisations, Institut de Sociologie de l'Université de Bruxelles*, 19:2, p. 169

²⁷⁵ Corriere Asia. (2021). Storia di Singapore. *Corriere Asia*. Retrieved from: <https://www.corriereasia.com/storia-di-singapore/>

end of the peninsula”.²⁷⁶ During the 11th century, this little and strategic island started to be called in Malay language *Singa Pura*, translated into English language as “the Lion City”. According to what is written on the Malay Annals, the legend tells us that the Malay Prince Sang Nila Utama from Palembang, Indonesia, saw a lion right after he came ashore at the Island of Singapore. This is the reason why, according to the legend, the city is called Singapore.²⁷⁷ These are the only detailed witnesses we have from the ancient roots of Singapore city-state. Nowadays, the Lion Head is seen as a national symbol, and it promotes a sense of national identity, symbolising courage, strength and excellence, three of the main values of the city-state.²⁷⁸

Singapore is located on the southern tip of the Malaysian Peninsula; thus, it is a focal point for different maritime routes. Indeed, during the centuries, different waves of migration from various places of the region have characterised the city-state’s history. Vessels from India, Near East, China, but also Portugal have reached its shores.²⁷⁹

However, United Kingdom gave an important contribution to the history of Singapore. The British rule was established in 1819 on behalf of Sir Stamford Raffles, a British politician, military and colonial administrator, as well as the founder of the city of Singapore. That year, Sir Stamford Raffles made an agreement with Johor, a state in Southern Malaysia connected to Singapore by a causeway, and it decided to establish a settlement on the Island of Singapore in the name of the East India Company. Shortly thereafter, the Island was ceded to United Kingdom.²⁸⁰ The main purpose of the British Colony was to establish a buffer zone in order to create a trading centre. They wanted to repair, supply and protect their crescent empire, and to prevent the advancement of Dutch vessels in the region.²⁸¹

The British settlement was a success. The population continued to grow, especially thanks to immigrants from China and India, from 150 Malays to more than 10.000 people

²⁷⁶ Ibid

²⁷⁷ National Heritage Board Singapore. The Lion Head Symbol. Retrieved from: <https://www.nhb.gov.sg/what-we-do/our-work/community-engagement/education/resources/national-symbols/the-lion-head-symbol>

²⁷⁸ Ibid

²⁷⁹ Corriere Asia. (2021). Storia di Singapore, op. cit.

²⁸⁰ Hassan, R. (1969). Population change and urbanisation in Singapore, op. cit.

²⁸¹ Ibid. See also Corriere Asia. (2021). Storia di Singapore. *Corriere Asia*. Retrieved from: <https://www.corriereasia.com/storia-di-singapore/>

of different ethnicities. Due to its strategic location, by 1830 Singapore had become one of the most important trading centres of Southeast Asia. Sir Stamford Raffles established a free trade policy there, thus, merchants from all over Asia were attracted by the possibility to trade freely; hence, this fact gave further impetus to the growth of Singapore trading centre.²⁸²

In 1869, the Suez Canal was opened, and, together with the use of the telegraph as a new mean of communication, it helped Singapore becoming a real trading hub of Southeast Asia.²⁸³

In 1942, during II World War, Singapore was occupied by Japanese armed forces, but, shortly thereafter, in 1945, British forces regained control of the island.²⁸⁴ Thus, after the war, Singapore returned to be a crown colony of the United Kingdom.

Before becoming totally independent, Singapore gained self-government in 1959 under Lee Kuan Yew, who became first chief minister after a series of communist riots and social crisis which upset the balance of the crown colony. Later on, Singapore gained its own Constitution. In 1963, Lee Kuan Yew proposed to create an agreement with Malaysia in order to integrate the two states. Hence, the Federation of Malaysia Agreement was signed amongst leaders of Malaysia, Singapore, Sabah and Sarawak on July 9, 1963. This agreement did not last long because of political disagreements, and, on August 7, 1965, Singapore and Malaysia signed a separation agreement. On August 9, 1965, Singapore declared independence. It finally became Republic of Singapore after gaining independence from the United Kingdom.²⁸⁵

Lee Kuan Yew did govern the city-state until 1990. It was succeeded by Goh Chok Tong, who continued to adopt the policy of economic development initiated by its

²⁸² Ibid. See also Corriere Asia. (2021). Storia di Singapore. *Corriere Asia*. Retrieved from: <https://www.corriereasia.com/storia-di-singapore/>

²⁸³ Corriere Asia. (2021). Storia di Singapore, op. cit.

²⁸⁴ Ibid. The Battle of Singapore was a crucial moment within the Singapore-Malaysia campaign. It was fought in Southeast Asia between II World War, from 8 December 1941 to 15 February 1942. The Battle of Singapore was the final moment of the campaign, and it ended with the Japanese attack on Singapore and the surrender of British forces. On the Japanese occupation and on British return see also Calder, K. E. (2016). *Singapore: Smart City Smart State*, Washington, D.C.: Brookings Institution Press, p. 177

²⁸⁵ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., pp. 177-178. See also Corriere Asia. (2021). Storia di Singapore. *Corriere Asia*. Retrieved from: <https://www.corriereasia.com/storia-di-singapore/>

predecessor. In 2004, Lee Hsien Loong, Lee Kuan Yew's son, took power until present. He faced important challenges, such as the full-scale globalisation and the Digital Revolution, but, following in his father's footsteps, he always maintained his leadership in a pragmatic and holistic way. Indeed, throughout the three leaderships so far, Singapore public policy has remained flexible and creative, especially thanks to its smart government and institutions, which have always been updated with the latest technology.²⁸⁶ For example, a unicameral legislature has made government leadership easier, in the sense that it has been more effective in responding to outside challenges, in contrast to more complex systems in Europe, United States or Japan. Moreover, a set of specialised statutory boards had been created during the first years of self-government, such as the Housing and Development Board (HDB-1960) and the Economic Development Board (EDB-1961). Even before self-government, under the colonial government, the Central Provident Fund (CPF-1955) was created. They focus on housing, economy and finance, respectively. Singapore has 65 statutory boards in total, and their principal aim is to deliver efficiently public services of multiple types.²⁸⁷

Singapore, during its early phases, faced various sociopolitical challenges. It is within this background that the People's Action Party (PAP)²⁸⁸ came to power in 1959, five years after it was founded in 1954. PAP found a number of challenges during the years following its foundation, including the prosecution of being radical and dominated by communists; thus, in 1961, it split in two, with 13 pro-communist PAP members who decided to form the Barisan Sosialis.²⁸⁹

Singapore could overcome different challenges thanks to its former leaders, who shared common experiences, personal characteristics and holistic approaches to problem-

²⁸⁶ Ivi, p. 30

²⁸⁷ Ivi, pp. 30-42. See also Singapore Government Directory. Statutory Boards, *Singapore Government Directory*. Retrieved from: <https://www.sgdi.gov.sg/statutory-boards> (last updated April 8, 2016)

²⁸⁸ The People Action's Party (PAP) is one of the three contemporary political parties represented in parliament in Singapore, the other two are the Workers' Party (WP) and the Progress Singapore Party (PSP). PAP is a conservative centre-right party, of which the Secretary-General is Prime Minister Lee Hsien Loong

²⁸⁹ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 32. The Barisan Sosialis (in English, Socialist Front) was a political party in Singapore and it formed on August 1961 by left-wing PAP assemblymen who had been expelled from PAP itself. It was the major opposition party in Singapore at that time

solving. Leaders distinguished themselves as the Old Guard, a group with shared commitment to collective welfare, to smartness and institutional flexibility and to cosmopolitan pragmatism that helped Singapore to face the challenges of globalisation.

Amongst the Old Guard, there were important political figures, such as Goh Keng Swee, who headed the EDB, Lim Kim San, who guided the HDB, Toh Chin Chye, who spearheaded the PAP, and Sinnathamby Rajaratnam, who served as Singapore's first foreign minister (1965-80), as minister of labour (1968-71) and as deputy PM (1980-85). S. Rajaratnam was a fundamental personality also because he participated in the negotiation process of Singapore's entry into the UN in 1965 and the Non-Aligned Movement in 1970. In addition, he was one of the founding fathers of ASEAN.²⁹⁰

Singapore has 16 ministries which perform the main functions of the government. Amongst these ministries, two of them deserve a more detailed description: one is the Ministry of National Development, which supervises the Urban Redevelopment Authority (URA) and the HDB. They are the key bodies implementing housing policies and enhancing political stability and socioeconomic progress. The second is the Ministry of Transport, which supervises the Land Transport Authority (LTA) and the Public Transportation Council (PTC). These bodies are responsible for mass transport policies; thus, they are also responsible for air pollution and traffic. Other particular ministries are: the Ministry of Environment and Water Resources, which manages water issues, the Ministry of Manpower, which direct human resource development, and the Ministry of Culture, Community and Youth, which works to promote the coexistence of different ethnicities within the same coherent nation.²⁹¹

Hence, the smart government of Singapore has a holistic view of doing politics; indeed, through its dynamic institutions and boards, it highlights the importance of group dynamics. The government continuously invests in young resources, by bringing new motivated people at work into important roles. Indeed, another distinctive system that has added to the number of effective practices of Singapore was Lee Kuan Yew's Principal Private Secretaries' system (PPS). It was a recruitment strategy which consisted on selecting young and energetic officials whom Lee considered prominent and whom he

²⁹⁰ Ivi, pp. 37-39

²⁹¹ Ivi, p. 41

mentored personally, while also sending them out of his office in order to make sure that they improved their skills and their holistic way of thinking.²⁹²

While the first phase of Singapore city-state formation was centred on state formation and consolidation, through an austere policy verging on soft-authoritarianism (which Singapore needed in order to strive and survive to external challenges in a period of state formation, during which stability and security were primary necessities at home and abroad), the second phase saw the leadership of Goh Chok Tong and Lee Hsien Loong capitalising on globalisation and the Digital Revolution.²⁹³

The Lion City became a knowledge-intensive hub, both from an economic and structural point of view. Singapore's second and third PM, Goh and Lee, pursued the same vision of its founder Lee Kuan Yew, and they could resize the smart institutions and infrastructures created before according to the changing and challenging knowledge-intensive and industrial system.²⁹⁴

The combination of specialised institutions, e-government introduction (one of the most important levers for the city today, until transforming e-government into an export industry) and a collaborative group of leaders have made Singapore one of the most flexible and responsive city-states today. This has been possible thanks to the efforts made and to the strength demonstrated in order to overcome challenging moments, such as the technological change and globalisation.

Thus, the achievements reached have been the result of the work of the three PM, but also of the broad leadership's network, the design of subnational organisations, such as statutory boards and ministries, meritocracy, respect of the rule of law and responsiveness.²⁹⁵

Actually, we are referring to the most dynamic technocracy of Asia. According to Parag Khanna, technocracy should be the form of government towards which every country should converge. It is not the perfect way of government, but it is forward-looking, it is

²⁹² Ivi, p. 46

²⁹³ Ibid

²⁹⁴ Ivi, pp. 49-60

²⁹⁵ Ibid

innovative, dynamic, holistic and inclusive. According to the scholar, democracies are stagnant and produce compromises, while technocracies produce the best solutions.²⁹⁶

In this sense, city-states, in their tiny scenario, represent the basis, the mere model for solutions to contemporary challenges of the 21st century, such as sustainable urbanisation, ethnic diversity management and rapprochement with the global economy.²⁹⁷

The fundamental advantage of city-states lies in the fact that they are used to think and organise themselves in a strategic way in order to survive to external challenges. This is exactly what Singapore has done since its first PM Lee took power. Professor Khanna, in his book “*La rinascita delle città stato*”, mentions the scholar from New Zealand David Skilling, who asserts that little states can have more success than bigger countries, because they are strategically coherent and they concentrate on their interests primarily, focusing on economic competitiveness and adapting to global circumstances. They are agile and always ready to change their policies, to innovate.²⁹⁸

The idea that a tiny city-state, such as Singapore, could be a model for other big states was not popular in the past and for many years, but the city-state started to be considered a role model since the advent of the 21st century. Nowadays, there is a number of city-states in the world, and they have the potential to be autonomous. The power is in the process of being transferred from big states to cities. Nowadays, small states maintain important positions. According to Khanna, there is an inverse relationship between the size of a nation and the opening process of its economy. Indeed, at the top there are countries such as Singapore, Switzerland, New Zealand, Finland, etc. Moreover, there is an inverse ratio between the Depth of Globalisation Index, the index that calculates the

²⁹⁶ Khanna, P. (2017). *La rinascita delle città-stato. Come governare il mondo al tempo della devolution*, Roma: Fazi Editore srl, I Ed., traduzione di Thomas Fazi, p. 36

²⁹⁷ Ivi, p. 60

²⁹⁸ Skilling, D. (2013). Strategic coherence and ruthlessness are allowing many smaller countries – from Singapore to Israel – to succeed in turbulent times, In *In Praise of Small States, Global Brief*. Retrieved from: <https://globalbrief.ca/2013/06/in-praise-of-the-small-states/>. See also Khanna, P. (2017). *La rinascita delle città-stato. Come governare il mondo al tempo della devolution*, Roma: Fazi Editore srl, I Ed., traduzione di Thomas Fazi, p. 61. Nations with a limited population are the richest in the world in terms of per capita income: Norway, Qatar, Luxembourg, Macao, Switzerland, Denmark, Sweden, Singapore. A further sub-group of small states is generally at the top of international rankings in economic freedom, competitiveness, attractiveness for foreign investment, social progress and efficiency of public institutions: Hong Kong, Singapore, New Zealand, Switzerland, Finland

impact of globalisation in the world, and the dimension of a country. Hong Kong, Singapore, Luxembourg, Belgium, the Netherlands have the primacy in this respect.²⁹⁹

Another important element that measures the quality of a country is the “efficient governance” and, by consequence, the strong bureaucracy. Nowadays, the bureaucracy of Singapore ranks first both in terms of administrative ability and autonomy. All members of the cabinet work together with senior state officials who know well the internal mechanisms of the government. According to Khanna, the bureaucracy of Singapore is like a spiral staircase: at every step, you learn to manage different and new skills, linking together a broad basic knowledge and first-hand experience. On the contrary, the American bureaucracy works like an elevator: one can enter the ground floor and move directly to the top, without learning what is in the middle.³⁰⁰

For example, in Singapore, Siong Guan Lim, a mechanical engineer, held the positions of permanent secretary of the Departments of Defense, Education and Finance and chaired the EDB and the Government Investment Corporation (GIC). Likewise, Peter Ho, former civil servant, is the Senior Advisor to the Centre for Strategic Futures (CSF), the internal think-tank of the government. He is also Chairman of the URA and other boards.³⁰¹ The experience gained in different government departments is what connects these people, in addition to the authority necessary to conduct independent research and the pursuit of policies able to overcome the barriers between the sectors of public administration.³⁰²

The current Head of Public Administration in Singapore, Peter Ong, has launched a process of diversification of the training of bureaucrats designed to meet the challenges of complexity. Today, the administration of the Republic is characterised by men of deep experience in matters such as economic strategy, infrastructure planning, environmental management, security and defense, social services and bureaucratic organisation. Urban

²⁹⁹ Khanna, P. (2017). *La rinascita delle città-stato. Come governare il mondo al tempo della devolution*, op. cit., p. 60

³⁰⁰ Ivi, p. 81

³⁰¹ Lee Kuan Yew World City Prize. Biography: Peter Ho, *Lee Kuan Yew World City Prize*. Retrieved from: <https://www.leekuaneyewworldcityprize.gov.sg/about/prize-jury/prize-council/peter-ho/>. See also Khanna, P. (2017). *La rinascita delle città-stato. Come governare il mondo al tempo della devolution*, Roma: Fazi Editore srl, I Ed., traduzione di Thomas Fazi, p. 82

³⁰² Khanna, P. (2017). *La rinascita delle città-stato. Come governare il mondo al tempo della devolution*, op. cit., p. 82

planning, for example, is entrusted to working teams in which architects, economists, demographers, environmental experts and other top-level professionals sit side by side.³⁰³

These horizontal mechanisms, on the contrary to vertical ones, pool resources and use them for functional challenges.

Concerning the environmental dimension, Singapore urban planning has an environmental thrust which differentiates it from other Asian cities. One of PM Lee Hsien Loong's policy goals is, indeed, nature conservation. During his speech at Serangoon for Clean and Green Singapore 2014, PM Lee affirmed that:

Staying clean and green in Singapore remains as important as ever, because today we have a bigger population, we consume a lot more energy, we generate quite a lot more waste material. We are a more built up city, so we have to work harder to preserve our green spaces. The Government is committed to doing this.³⁰⁴

Singapore is known as the Garden City, and this achievement has been possible thanks to the efficient government's commitment and to the engagement of the community in keeping Singapore clean and green. The day of its discourse for Clean and Green Singapore, PM Lee said:

We must not litter, we should clear our plates after eating, and we should save energy and water. Most people do it, but unfortunately there is a minority of Singaporeans who do not respect our environment. ... The Government has tightened enforcement, and will review our penalties to punish littering and to stop littering.³⁰⁵

As can be inferred from the words above, PM Lee is strongly committed towards environmental protection up to the point of punishing who litters.

As already said in the second chapter, Singapore's government has worked significantly in order to maintain green spaces in the city. The initiative began in 1963 when PM Lee

³⁰³ Ibid

³⁰⁴ Prime Minister's Office Singapore. (2013, October 26). Speech by Prime Minister Lee Hsien Loong at the Launch of Clean and Green Singapore 2014, *Prime Minister's Office Singapore*. Retrieved from: <https://www.pmo.gov.sg/Newsroom/speech-prime-minister-lee-hsien-loong-launch-clean-and-green-singapore-2014> See also the video of the speech: <https://www.youtube.com/watch?v=TNSQ44NeveA&t=26s>

³⁰⁵ Ibid

Kuan Yew decided to begin a tree planting campaign, carried out by his successors. In 2008, for example, the URA launched a new Island-wide Leisure Plan, which comprehended the creation of new green spaces, but also other recreational options, such as new water activities along the rivers and reservoirs across the island and new sporting facilities close to home. Moreover, another Leisure Plan's aim was to enlarge the Park-Connector Network (PCN), a series of green pedestrian roads and cycle paths which have promoted walking and cycling activities in Singapore. The PCN area increased from 100 to 360 kilometres.³⁰⁶ Furthermore, the SGP2012, Singapore's ten-year plan for achieving sustainable development, established a National Biodiversity Reference Centre in 2006, now called National Biodiversity Centre (NBC), a centre which manages biodiversity-related resources in Singapore.³⁰⁷ In addition, SGP2012 created a Community-in-Bloom (CIB) programme, a gardening movement which aims at making Singapore a City in Nature. The gardening programme has been launched in 2005 and it has more than 1600 community gardens across the city, with more than 40.000 gardeners.³⁰⁸

Generally, the Garden City project in Singapore assumed a technocratic approach in order to solve the negative environmental impacts due to rapid modernisation and urbanisation processes, demonstrating the government's predisposition for environmental governance. Indeed, in 2014 Singapore won the title of United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage city-state for its Botanic Gardens.³⁰⁹

³⁰⁶ Urban Redevelopment Authority (URA). (2008, May 21). URA launches new Island-wide Leisure Plan. About the Draft Master Plan 2008, *Urban Redevelopment Authority*. Retrieved from: <https://www.ura.gov.sg/Corporate/Media-Room/Media-Releases/pr08-54>. See also a descriptive online map on National Parks Board. Recreational Connectivity. Explore nature throughout Singapore – walk or cycle on enhanced routes. *National Parks Board*. Retrieved from: <https://www.nparks.gov.sg/gardens-parks-and-nature/park-connector-network>

³⁰⁷ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 121. See also Chew, V. (2016, August 17). Singapore Green Plan, *Singapore Infopedia*. Retrieved from: https://eresources.nlb.gov.sg/infopedia/articles/SIP_1370_2008-11-22.html. See also National Parks Board. National Biodiversity Centre, *National Parks Board*. Retrieved from: <https://www.nparks.gov.sg/biodiversity/national-biodiversity-centre>

³⁰⁸ Ibid. See also National Parks Board. Community in Bloom initiatives, *National Parks Board*. Retrieved from: <https://www.nparks.gov.sg/gardening/community-in-bloom-initiative>

³⁰⁹ Han, H. (2017, March). Singapore, a Garden City, In *The Journal of Environment & Development*, Sage Publications, Inc, 26:1, pp. 3-24

As seen in chapter two, Singapore is the 8th greenest city in the world, according to Resonance Consultancy analysis. Moreover, according to the Asian Green City Index, a research project conducted by the Economist Intelligence Unit and sponsored by Siemens, Singapore was named as number one on average in the overall results in 2011, rating as “well above average” within the eight categories analysed (energy and CO₂, transport, water, air quality, land use and buildings, waste, sanitation, environmental governance).³¹⁰

3.3 Singapore as a green city-state: leadership in sustainability

The former Minister of the Environment Lim Swee Say, who took office from 2001 to 2004, at the launch of SGP2012 said:

...There is a general consensus that the three key pillars of sustainable development are economic growth, social progress and environmental protection. Members of the global community share the view that to achieve sustainable development, we need to harmonise these three key pillars. ... We do not allow the lack of natural endowment to determine our fate. ... Instead, we look ahead, plan for the future, set clear targets, and pursue the necessary policies head on with clear thinking and concrete strategies. ... However, the successful implementation of SGP2012 will not ... happen overnight. All of us must be prepared to play our part, and commit ourselves to act in a timely and responsive way.³¹¹

As previously stated, SGP2012 was adopted in 1992, it was the first Green Plan ever for the city-state. This was possible and, at the same time, necessary because of the city-state’s rapid industrial growth and urbanisation process at that time, and essentially the lack of natural resources. Moreover, due to the limited land, land-use planning has been addressed carefully, and strict pollution control standards have been imposed, such as remarkable air-quality standards and an efficient transit system.³¹²

³¹⁰ Economist Intelligence Unit. (2011). *Asian Green City Index*, op. cit., pp. 10-11

³¹¹ Media Relations Division, Ministry of Information, Communications and the Arts. Discourse by the Minister of the Environment Lee Swee Say at the launch of the Singapore Green Plan 2012, op. cit.

³¹² Johnson, H. D. (2008). *Green Plans: blueprint for a sustainable earth*, op. cit., pp. 155-156

Even at that time, Singapore was one of Asia's leaders in efficient services use and in environmental practices and solutions. Indeed, as the country developed, it could adapt quite easily to new environmental technologies for industries and urban infrastructures.

The first Green Plan was presented at the Johannesburg World Summit on Sustainable Development in 2002; its aim was to move Singapore towards an environmental sustainability by 2012 through the following steps: ensuring a good quality of living through an efficient use of few resources and promoting the active participation and collaboration of all sectors of the society in order to reach a high-quality environment. Thus, the government has always tried to connect people through common challenges, climate change above all, in order to raise awareness on the matter. It acts as a mediator for the population of all sectors in order to strengthen the message of environmental sustainability.³¹³

On February 10, 2021, Singapore adopted the Singapore Green Plan 2030 (SGP2030), which aim is to strengthen Singapore's commitment under the UN's 2030 Sustainable Development Agenda and Paris Agreement over the next 10 years, and to reach the fundamental goal of achieving net-zero emissions as soon as possible.³¹⁴

The key points of this plan are:

- City in Nature: by 2030, Singapore will be a green city which will allow humans and wildlife to live in harmony. Around 200 hectares of land (about 50%) will be devoted to natural parks, and one million more trees will be planted across the island; in this way, they will absorb 78.000 tonnes of CO₂, thus, more clean air will be available for the life in the city;
- Energy Reset: by 2030, solar energy deployment will quintuple and green buildings will increase of 80%. Natural gas, the cleanest fossil fuel available on Earth, is already in use. Electric vehicles (EVs) are spreading more and more, and Singapore is adopting the right urban environment in order to host EV. These efforts will reduce energy consumption by about 8 million megawatt hours per year. In turn, domestic GHG emissions will decrease by 3 million tonnes per year;

³¹³ Ivi, pp. 157-158

³¹⁴ Singapore Government Website. Singapore Green Plan 2030, op. cit. See also <https://www.youtube.com/watch?v=oNFeO17pW9s>

- Green Economy: addressing climate change is a competitive advantage for Singapore. Various steps at the entrepreneurial level had been taken in order to tackle this problem, such as the creation of the Enterprise Sustainability Programme to help enterprises be always updated on environmental trends. Companies develop their R&D activities to acquire more sustainable skills;
- Resilient Future: by 2030, Singapore will increase greenery in order to mitigate urban heat, and it will make its food supply more resilient through at least 30% of locally produced food;
- Sustainable Living: circular economy in Singapore is essential, since its few resources can be recycled and used many times.³¹⁵ By 2030, walking, cycling and mass public transport usage will be encouraged even more. Young people are trained through specific programmes, such as the Eco Stewardship Programme, in order to better understand climate change and sustainable needs from an early age.³¹⁶

Singapore sustainability programme is a model for other developing countries of the region. This is true thanks to its innovative policies and plans, but also thanks to the Ministry of the Environment's ability to enforce and monitor actively these policies. As the scholar Huey D. Johnson asserted, Singapore is small, but it is a model for giants.³¹⁷

3.3.1 Green buildings in Singapore

Green buildings are a fundamental element for Singapore city-state. Since Singapore is a highly urbanised island, buildings represent at least 20% of its carbon emissions. Hence, green buildings are an important mitigation strategy for the city-state.³¹⁸

In 2005, the Singapore Building and Construction Authority (BCA) initiated a program of greenery in Singapore, the Green Mark scheme, in order to promote sustainable buildings in the urban area. Furthermore, in 2009 the Singapore Green Building Council

³¹⁵ NEWater and NEWSand are two systems included in the circular economy of Singapore. The first one is used in order to recycle used water into ultra-clean and reclaimed water, while the second one is used in order to transform incinerated waste into a road base or sub-base material for road construction projects

³¹⁶ Singapore Government Website. Singapore Green Plan 2030, op. cit. See also <https://www.youtube.com/watch?v=oNFeOI7pW9s>

³¹⁷ Johnson, H. D. (2008). *Green Plans: blueprint for a sustainable earth*, op. cit., p. 159

³¹⁸ Building and Construction Authority (BCA). (2021, February). Singapore Green Building Masterplan. Public Engagement Report, *Building and Construction Authority (BCA)*, p. 3

(SGBC) was formed thanks to the commitment and enthusiasm of the industrial and academic sectors. Since then, SGBC has driven green building advocacy in Singapore. Actually, more than 40% of buildings in Singapore are considered green; by 2030, the goal is to double green buildings according to the next Singapore Green Building Masterplan (SGBMP). BCA and SGBC are working in synergy with stakeholders in order to push environmental sustainability in buildings.³¹⁹

According to a BCA survey destined to Singapore citizens, 9 out of 10 respondents are sure that green buildings represent a fundamental strategy to fight climate change, demonstrating their high level of awareness and their sense of urgency. Moreover, more than 9 out of 10 recognise that more urgent measures should be put in practice in order to transform green buildings into Super Low Energy Buildings.³²⁰ In line with the survey, the top three benefits of building green structures are: lower carbon emission standards, environmentally friendly buildings and better health and well-being for the population.³²¹

SGBMP's goal is to achieve three main targets by 2030; the challenge is called "80-80-80 in 2030". First of all, the fundamental target is to reach 80% of greenery in Singapore's buildings by Gross Floor Area (GFA). BCA has updated the Green Mark scheme in order to increase green emphasis on buildings and to ensure healthier quality of living for building users, thus, the Green Mark 2021 scheme is strictly connected with UN's SDGs; secondly, Singapore needs 80% new developments in order to transform its buildings into Super Low Energy buildings; thirdly, it aims at reaching 80% improvement in energy efficiency for green buildings.³²²

³¹⁹ Ibid. See also Building and Construction Authority (BCA). Green Building Masterplans, *Building and Construction Authority (BCA)*. Retrieved from: <https://www1.bca.gov.sg/buildsg/sustainability/green-building-masterplans>. See also Building and Construction Authority (BCA). Green Mark Certification Scheme, *Building and Construction Authority (BCA)*. Retrieved from: <https://www1.bca.gov.sg/buildsg/sustainability/green-mark-certification-scheme>

³²⁰ Building and Construction Authority (BCA). (2021, February). Engagement Report Infographic, *Building and Construction Authority (BCA)*. Retrieved from: https://www1.bca.gov.sg/docs/default-source/docs-corp-buildsg/sustainability/report-infographics.pdf?sfvrsn=c891f6d2_0

³²¹ Ibid

³²² Building and Construction Authority (BCA). (2021, February). "80-80-80 in 2030" Infographic, *Building and Construction Authority (BCA)*. Retrieved from: https://www1.bca.gov.sg/docs/default-source/docs-corp-buildsg/sustainability/sgbmp-80-80-80-in-2030-infographic.pdf?sfvrsn=57172d48_2

There are also other advantages to the construction of sustainable buildings, besides being environmentally friendly and healthy for the population. For example, steel and other dry materials take less time to construct a building than wet concrete. They also save labour usage up to 30% less, and they are of better quality since materials are standardised and fabricated in the factory before usage, rather than concrete material use which depends on labourers' skills. Furthermore, and not least, steel-based materials are recyclable, indeed, over 50% of steel materials are produced from other scrap materials; on the contrary, concrete is highly pollutive, reaching 1 or 2 tonnes of CO₂ released into the atmosphere every ton of cement produced.³²³

Green buildings are of fundamental importance for our future, and common action is needed in order to save the urban environment and life conditions. Singapore has proved to be climate resilient, but actually it is trying to improve every year in order to face environmental challenges which future generations will suffer most.

There are plenty of impacting green structures in the city-state. Two of them are particularly attracting, because they host many people and their major focus is to take care of people's wellness inside them. They are the Nanyang Technological University Singapore and the Khoo Tech Puat Hospital.

3.3.2 Nanyang Technological University Singapore

Nanyang Technological University Singapore (NTU Singapore) is a public autonomous research-leading university in Singapore that hosts about 33.000 students; it is quite young, since it was founded in 1991. It is divided in 8 colleges and schools, namely Nanyang Business School, College of Engineering, College of Humanities, Arts and Social Sciences, College of Science, Lee Kong Chian School of Medicine, Graduate College, National Institute of Education and S. Rajaratnam School of International Studies. These colleges' educational schemes distinguish from others since they aim at establishing direct contacts between professors and students through a holistic and

³²³ Building and Construction Authority (BCA). (2021, February). Sustainable Construction, *Building and Construction Authority (BCA)*. Retrieved from: <https://www1.bca.gov.sg/buildsg/sustainability/sustainable-construction>

innovative way of teaching accompanied by interdisciplinary learning. Indeed, NTU ranks 12th in the QS World University Ranking 2022 and 2nd in Asia.³²⁴

The key pillars that drove the construction of NTU's campus are sustainability, eco-friendly environment and innovative building technology.³²⁵

The majority of NTU's buildings, besides their unique architectural design, are considered high-performance green buildings, according to the Green Mark scheme. Indeed, 53 green buildings have won the BCA's Green Mark Platinum award, while, in 2016, NTU was recognised as the first BCA's Green Mark Platinum ^{STAR} Champion.³²⁶

NTU's major goal is to become the greenest campus in the world, and it is achieving this through its EcoCampus initiative. EcoCampus is an initiative that was launched in April 2014 in order to connect the university, agencies and industries through R&D projects, using NTU as a Living Lab Testbed. EcoCampus initiative will come to an end at the end of 2021, after having successfully achieved set goals, such as reducing energy and water usage by 35% by 2020. This initiative hosts a number of projects under different areas: 12 projects under Green Building Systems for the Tropics, 7 projects under Renewable Energy Integration and Smart Grids, 4 projects under Sustainable Urban Mobility, 5 projects under Energy Information Analytics and 4 projects under User Behaviour for Sustainability. The total number of industry collaboration is 28.³²⁷

Two of its latest architectural designs need further attention: The Wave and the new students' residences at Nanyang Crescent.

The Wave is the latest sports structure of NTU and first large-scale building in Southeast Asia constructed with Mass Engineered Timber (MET), a particular building material

³²⁴ Nanyang Technological University Singapore (NTU Singapore) website. Colleges & Schools. Retrieved from: <https://www.ntu.edu.sg/education/colleges-schools>. See also QS World University Rankings 2022. Retrieved from: <https://www.topuniversities.com/university-rankings/world-university-rankings/2022>

³²⁵ Building and Construction Authority (BCA). (2017, May). NTU, a living lab for sustainability, gets greener, In Pillars, *Building and Construction Authority (BCA)*. Retrieved from: <https://www.bca.gov.sg/emailsender/microsite/Pillars-052017/future-ready1.html>

³²⁶ Ibid

³²⁷ Nanyang Technological University Singapore (NTU Singapore) website. EcoCampus. Retrieved from: https://www.ntu.edu.sg/erian/research-focus/flagship-programmes/ecocampus#Content_C012_Col00. See also Building and Construction Authority (BCA). (2017, May). NTU, a living lab for sustainability, gets greener, In Pillars, *Building and Construction Authority (BCA)*. Retrieved from: <https://www.bca.gov.sg/emailsender/microsite/Pillars-052017/future-ready1.html>

composed of engineered wood products with structural resistance and integrity.³²⁸ It was constructed through innovative technologies: a wave-like roof of 72 metres composed of MET, which is in turn composed of sustainable wood from forests (MET provides better heat insulation than concrete, in addition to less noise and manpower); a three-floor interior, which hosts three basketball courts and 13 badminton courts; eco-friendly elements, such as double-skin walls able to insulate against heat and to cool the air thanks to metallic coils, so an air conditioning system is not necessary, and energy-saving mechanisms, such as LED lighting and solar-powered systems.³²⁹



Figure 4. The Wave

Students' residences at Nanyang Crescent is a Lego-style assemblage of units constructed with Prefabricated Pre-finished Volumetric Construction (PPVC), an innovative construction technology in the building sector. Nanyang Crescent residences are amongst the very first public skyscrapers buildings constructed with PPCV. This construction method carries with it various benefits, amongst them the reduction of

³²⁸ Building and Construction Authority (BCA). (2017, May). NTU, a living lab for sustainability, gets greener, op. cit. See also Building and Construction Authority (BCA). Mass Engineered Timber, *Building and Construction Authority (BCA)*. Retrieved from: <https://www1.bca.gov.sg/buildsg/productivity/design-for-manufacturing-and-assembly-dfma/mass-engineered-timber>

³²⁹ Ibid

working time and manpower needed, since the building components are prefabricated off-site, less noise and less pollution.³³⁰

All in all, the key for successfully constructing new technological and green buildings lies in the strong collaboration between different stakeholders, such as in the case of these types of green buildings.



Figure 5. Nanyang Crescent Residences

NTU has publicly announced its Sustainability Manifesto, a series of objectives within the green agenda that the University wants to achieve by the next 15 years. The main goals are: carbon neutrality by 2035 (50% GHG reductions), 100% Green Mark Platinum certification for eligible buildings in the campus, energy use reduction (50%), water and waste usage diminution by 2026, introduction of sustainability programmes into the students' curricula, promotion of sustainable food production and consumption, support of UN SDGs 2030, and partnerships increase with industries and partners, including 7 multinationals, for developing major sustainable projects.³³¹ Moreover, a NTU Sustainability Office has been established in order to drive commitments towards sustainability objectives.³³²

³³⁰ Ibid

³³¹ Ibid. See also Nanyang Technological University Singapore (NTU Singapore) website. NTU President Prof Subra Suresh's message on Sustainability. *Nanyang Technological University Singapore (NTU Singapore)*. Retrieved from: https://www.youtube.com/watch?v=hCzMJ_fJPUA&t=273s

³³² Ibid

As a leading research campus, inside it there is a plant for collecting and treating the solid waste produced, designed and operated by NTU faculty researchers and staff. Furthermore, there are also autonomous vehicles which go on an especially designed track, tested through industrial and academic partnerships. In addition, NTU designed a testbed for renewable energy to develop and test energy solutions for urban communities.³³³

Nowadays, the focus of NTU researchers is to stay in line with UN SDGs 2030 in order to fight the challenge towards climate change and to guarantee sustainable solutions for its students, academics, researchers, partners, and for the population overall.³³⁴

3.3.3 Khoo Tech Puat Hospital

The Khoo Tech Puat Hospital (KTPH) is a 795-bed multi-care hospital, located on a 3.4 hectares site at Yishun, Singapore. It was officially opened in November 2010.³³⁵

Every opportunity has been maximised for the creation of therapeutic green spaces, every angle of the building looks at garden roofs, so that patients and staff can feel better, providing with a reassuring scenario; moreover, at the centre of the hospital lies a vertical garden. Over 70% of the plants are indigenous, including rare and endangered species. It also hosts over 100 butterfly species. Volunteers in the community contribute actively in the conservation efforts of its green spaces and ecosystem.³³⁶

In the psychological literature, it has been demonstrated that, while viewing nature just for a few minutes, good feelings are enhanced, pulling away negative effects that cold hospitals can bring to patients.³³⁷

Since most of its space is occupied by gardens, it can be said that it is a hospital in a garden, and not the other way around. This feature is unique of KTPH, and this is the

³³³ Nanyang Technological University Singapore (NTU Singapore) website. NTU President Prof Subra Suresh's message on Sustainability, *Nanyang Technological University Singapore (NTU Singapore)*.

Retrieved from: https://www.youtube.com/watch?v=hCzMJ_fJPUA&t=273s

³³⁴ Ibid

³³⁵ National Parks Board & Greenroofs.com. (2020, February 19). Khoo Tech Puat Hospital (KTPH), *Greenroofs.com*. Retrieved from: <https://www.greenroofs.com/projects/khoo-teck-puat-hospital-ktp/>

³³⁶ Greenroofs.com. (2014, March 24). Khoo Tech Puat Hospital – Project of the Week 2/24/14. Retrieved from: <https://www.youtube.com/watch?v=oU3pDxP1rUo&t=105s>

³³⁷ Alexandra Health. (2020, September 30). *A Healing Space. Creating Biodiversity at Khoo Tech Puat Hospital*, Yishun Health: Singapore, pp. 12-13

reason why it is a leading hospital in Singapore. Indeed, it was created with three concepts in mind to follow: self-sustaining and practical gardens, creation of a connection between patients and nature, energy and resource-efficiency and environmentally-friendly spaces.³³⁸

Liak Teng Lit, Chief Executive Officer of Alexandra Health, the major health company of Singapore, said:

Right from the start, KTPH was conceptualised as a ‘hospital in a garden, and a garden in a hospital’. When we built KTPH, we ensured that for every square metre of land we took, we added three square metres of greenery. Despite our compact size, we achieved this by having vertical gardens which also complement the building’s facade and sleek lines. Our intention was to create a healing environment through gardens to engage the senses of sight, sound, scent and touch for our patients, visitors and staff.³³⁹

It is fundamental to say that gardens were installed inside KTPH in order to transform the hospital into a dynamic, holistic and nature-friendly environment which could be able to connect people with nature.³⁴⁰

The building is created through energy-efficient and wastewater usage mechanisms, such as solar panels or rain sensors. Water and garden plants in the interior serve as natural cooling systems.³⁴¹

³³⁸ National Parks Board & Greenroofs.com. (2020, February 19). Khoo Tech Puat Hospital (KTPH), op. cit.

³³⁹ Ibid

³⁴⁰ Alexandra Health. (2020, September 30). *A Healing Space. Creating Biodiversity at Khoo Tech Puat Hospital*, op. cit., p. 72

³⁴¹ Ivi, pp. 10-17



Figure 6. Khoo Tech Puat Hospital

KTPH, thanks to its sustainability efforts and commitments, ranked 1st in the Skyrise Greenery Awards 2010, proclaimed by Singapore National Parks and Singapore Institute of Architects (SIA). Moreover, it won the BCA Green Mark Platinum Award for buildings.³⁴²

3.4 Singapore as a smart city-state

The smart city concept, as already mentioned in the second chapter, is the new paradigm in order to better understand the role of cities in the context of the challenging 21st century. The same concept can be applied also to states. Nation-states need a change in perspective in order to confront with the challenging contemporary world. According to Calder, the Smart State (SS) concept is needed, both normatively and empirically. In that respect, Singapore symbolises the SS in action, since it has two fundamental characteristics: it is minimalist and enabling.³⁴³

Concerning minimalism, the SS assumes a low-profile, but indispensable for internal and external interactions. Indeed, it acts as an entrepreneurial state which provides the essential conditions for acting with efficiency and transparency in the international arena,

³⁴² National Parks Board & Greenroofs.com. (2020, February 19). Khoo Tech Puat Hospital (KTPH), op. cit. See also Alexandra Health. (2020, September 30). *A Healing Space. Creating Biodiversity at Khoo Tech Puat Hospital*, Yishun Health: Singapore, p. 17

³⁴³ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 63

avoiding dominating roles. Such minimalism allows the state to be actor-centred, and thus it provides social inclusion. Singapore is an example of minimalist city-state, starting from its administrative personnel, since it attempts to select its staff under strict meritocratic rules, to its low public budget. For what concerns the second feature, the SS is enabling since it provides the society with all the necessary tools, such as resources, information, etc. The SS enables citizens and economic actors to be self-reliant, but it controls its internal stability under internal rules. Singapore is enabling, since the government interacts actively with business, and it enables society to have all necessary facilities, also thanks to innovative technologies that larger states sometimes don't have.³⁴⁴

The distinctive features of Singapore's government in social and economic areas distinguish the Lion City from others, and they allow it to be a global model in the region and beyond.

The three key aspects which differentiate Singapore from other nation-states are social protection, economic development and national security, all three embedded within enablement and minimalism. These are the elements which made the breakthrough to the concept of SS; indeed, Singapore could successfully adapt to the challenges imposed by the current century, in particular to technological change.³⁴⁵

Concerning social welfare, government's programs are minimalist since are cost-effective in terms of expenditures, yet they are followed by other major Asian nations, such as China and South Korea.³⁴⁶ The health care system, for example, is a focal point in social welfare. In comparison to the Western system, the Singaporean government focuses on less health care expenditures, but on a broad health care coverage. Hence, it is enabling, since it allows all the people from different social sectors to have access to the health care system. In addition, through the CPF, citizens have to pay high co-payments in order to save money during their lifetime through individual saving accounts. This is what differentiates Singapore from many other Western countries, for example. It tries to

³⁴⁴ Ibid

³⁴⁵ Ivi, p. 64

³⁴⁶ Ivi, p. 67. See also Asian Development Bank (ADB). (2013). *The Social Protection Index Database: Assessing Results for Asia and the Pacific*, Manila, Philippines: Asian Development Bank (ADB), pp. xii-xiii

help citizens through tax-advantaged insurance and saving programs.³⁴⁷ One of these saving programs is MediSave, a medical savings account system within the CPF used to pay medical expenditures.³⁴⁸ Singapore's CPF is one of the most successful savings mechanisms in the world and a striking policy instrument. One of the reasons of this statement is that it is holistic in its nature. It provides for a full coverage scheme, comprehending health care, retirement, education, housing. In this way, it provides a sense of community and security to citizens, enabling them to live peacefully in a diverse ethnic environment, such as the one of the Singaporean community.³⁴⁹

Another fundamental milestone of Singapore's smart city-state is the HDB. It is the board that provides citizens with opportunities to buy public housing using their CPF account's savings. An important outcome is that Singapore has become a place where all citizens have a "stake" in society, in the sense that they can buy their own public house through their CPF savings thanks to opportunities given by the HDB. Actually, Singapore is implementing holistic measures even more on a sustainable basis. Desmond Lee, Singaporean Minister for National Development, is implementing strong measures in order to offer affordable, inclusive and liveable public housing to all Singaporeans.³⁵⁰

Historically speaking, at the beginning of its mandate as a self-managed city-state, Singapore had many challenges to face, also due to II World War damages. In 1959, it had many housing problems, the building sector was in crisis, and less than 10% of the people owned their own home.³⁵¹ Later on, in 1960, PM Lee Kuan Yew promoted the Housing and Development Act, which in turn created the HDB. This achievement

³⁴⁷ Ivi, pp. 68-71. See also Ministry of Health Singapore. (2018, March 7). Speech by Mr Gan Kim Yong, Minister for Health, at the Ministry of Health Committee of supply debate 2018, *Ministry of Health Singapore*. Retrieved from: <https://www.moh.gov.sg/news-highlights/details/speech-by-mr-gan-kim-yong-minister-for-health-at-the-ministry-of-health-committee-of-supply-debate-2018>

³⁴⁸ Central Provident Fund Board. MediSave, *Central Provident Fund Board (CPF)*. Retrieved from: <https://www.cpf.gov.sg/members/schemes/schemes/healthcare/medisave>

³⁴⁹ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 75

³⁵⁰ Ivi, p. 76. See also Housing and Development Board (HDB). (2021, March 4). Ensuring Public Housing Remains Affordable, Inclusive, and Liveable. Speech by Mr Desmond Lee. *Housing and Development Board (HDB)*. Retrieved from: <https://www.hdb.gov.sg/cs/infoweb/about-us/news-and-publications/press-releases/04032021-Ensuring-public-housing-remains-affordable-inclusive-and-liveable>

³⁵¹ Chew, V. (2010). Public Housing in Singapore, *Singapore Infopedia*. Retrieved from: https://eresources.nlb.gov.sg/infopedia/articles/SIP_1585_2009-10-26.html

strengthened the housing policy of Singapore, helping those poor or without a home. Since then, HDB worked efficiently in order to guarantee public housing for all.³⁵² Nowadays, according to the Sample Household Survey (2018), residents' satisfaction about their flat and their neighbourhood is above 90%. Moreover, 84.1% of people are satisfied with walkability, accessibility to transport and commercial facilities, meaning that Singapore is a self-sufficient city-state.³⁵³

These characteristics make Singapore a unique smart city-state in all its features, because it firstly takes into account citizens and permanent residents' satisfaction in all contexts, and then it tries to improve according to people's demands.

Concerning ethnic diversity, Singapore is a city-state with very different social and cultural backgrounds: it has an ethnic majority of Chinese people (74.2%), followed by a Malay minority (13.7%) and an Indian minority (8.9%).³⁵⁴ Since for many years Singapore faced many challenges concerning ethnic pluralism, now it is giving more and more a sense of common identity to its citizens, emphasizing a sense of independency and development also at institutional level, such as in schools, libraries, museums. The government is continuously striving in order to guarantee social stability and order, and it functions well with housing and language policies.³⁵⁵ These inclusive policies have been elaborated mainly by the HDB and the People's Association (PA), the very first boards established in Singapore after self-government. Actually, the PA has more than 1800 grassroots organisations (GROs), which are managed by PA volunteers with the goal of achieving "one people, one Singapore". The PA keeps permanently in touch with members of the grassroots organisations through different communities and councils: the Active Ageing Council (AA Council), the Community Club Management Committees (CCMCs), the Community Sports Clubs (CSCs), the Community Sports Clubs Council (CSC Council), the Community Emergency and Engagement (C2E) Committees, the Citizens' Consultative Committees (CCCs), the Malay Activity Executive Committees

³⁵² Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 76

³⁵³ Housing and Development Board (HDB). (2021, February 14). Sample Household Survey 2018: The HDB Living Experience, *Housing and Development Board (HDB)*. Retrieved from: https://www.hdb.gov.sg/cs/infoweb/about-us/news-and-publications/press-releases/14022021_Sample_Household_Survey_2018

³⁵⁴ Department of Statistics Singapore. (2021). *Population Trends 2021*, Singapore: Department of Statistics, Ministry of Trade & Industry, p. 4

³⁵⁵ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 79

Council (MESRA), the Indian Activity Executive Committees Council (IAECC), the Neighbourhood Committees (NCs), the People's Association Youth Movement (PAYM), the Residents' Committees (RCs), the Resident's Network (RN), the Residents' Network Council (RN Council), and the Women's Integration Network Council (WIN Council).³⁵⁶ Furthermore, there are also Community Clubs (CCs), which are clubs for people of all ethnicities; the main aim is to promote social integration.³⁵⁷

Singapore's leadership is focused on its citizens first; it helps them growing personally. Leaders have concentrated on different fields, such as education, job training, entrepreneurship, domestic skills. They view these social fields as enabling, dynamic and efficient. They invest on people in order to create a better nation.

For what concerns education, Singapore's government established the Edusave program, which is a fund directed to young Singaporeans (7-16 years old) students. Since their seventh year of age, Singaporean children receive a government fund of minimum S\$200 annually. This amount can vary depending on students' academic rankings. Furthermore, the government also helps students and their families with a Post-Secondary Education Account co-savings mechanism, which allows the government to contribute to families' higher education expenditures. Unspent funds directly go to students' CPF account which will be opened at the age of 30.³⁵⁸

Singapore puts great emphasis on job training, indeed, it performs training programmes in order to improve workers' skills and productivity, and to remain competitive in the global arena. Job training courses and initiatives are constantly revised by the Ministry of Manpower, which is represented by the National Productivity Council and the Singapore Workforce Development Agency. Singapore, thanks to its brilliant performances in job

³⁵⁶ People's Association (PA). Grassroots Organisations, *People's Association (PA)*. Retrieved from: <https://www.pa.gov.sg/our-network/grassroots-organisations>. See also Calder, K. E. (2016). *Singapore: Smart City Smart State*, Washington, D.C.: Brookings Institution Press, p. 81

³⁵⁷ People's Association (PA). Community Clubs, *People's Association (PA)*. Retrieved from: <https://www.pa.gov.sg/our-network/community-clubs>

³⁵⁸ Ministry of Education Singapore. (2021, October 18). Edusave Account: Overview, *Ministry of Education Singapore*. Retrieved from: <https://www.moe.gov.sg/financial-matters/edusave-account/overview>. See also Calder, K. E. (2016). *Singapore: Smart City Smart State*, Washington, D.C.: Brookings Institution Press, p. 86

training schemes and educational investment, ranks amongst the first nations with high-skilled workers.³⁵⁹

Concerning entrepreneurship, Singapore's Ministry of Trade and Industry fosters entrepreneurs' programmes through active projects, such as new start-ups. Entrepreneurship and education are connected, since there are many entrepreneurial programmes now in schools. For example, in 2013, Singapore's Ministry of Education started an entrepreneurship programme for secondary schools in partnership with the Action Community for Entrepreneurship (ACE).³⁶⁰ Hence, students are trained in a holistic manner in order to improve their soft skills now highly demanded in the working field.

Ministries and statutory boards are a fundamental part of Singapore's smart city-state. In addition to them, there are also government-linked companies (GLCs), which rely both on government and market. They are the so-called hybrid companies, such as Changi Airport International, Port of Singapore Authority (PSA), Jurong International, Singapore Airlines. These hybrid enterprises are funded by the Temasek Holdings, a public Singaporean investment company. Privatisation and corporatisation of companies have been two imperatives for the 21st century, owing to rapid technological change and globalisation process. Companies have thus enhanced their operational efficiency, leaving policymaking affairs to the government.³⁶¹ This could be possible because Singapore SS is composed of small independent units, such as statutory boards and GLCs, developed on a market-oriented basis. For example, EDB is one of the most important statutory boards of Singapore. The EDB's main focus is to create solutions for stakeholders, and, at the same time, to increase a sustainable economic growth for Singapore. Indeed, Singapore's EDB is "a government agency under the Ministry of Trade and Industry, [which] is responsible for strategies that enhance Singapore's position as a global centre for business, innovation, and talent".³⁶² EDB's efficiency stems from the fact that it is isolated from politics, but it is a fundamental character of the

³⁵⁹ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 87

³⁶⁰ Ibid

³⁶¹ Ivi, pp. 89-90

³⁶² Economic Development Board (EDB) Singapore. About EDB, *Economic Development Board (EDB) Singapore*. Retrieved from: <https://www.edb.gov.sg/en/about-edb/who-we-are.html>

market. In this way, it works in synergy with other companies, also foreign ones, enhancing their competitiveness in the economic arena through innovative solutions.³⁶³

In the international relations' arena, Singapore approaches to the global scenario in a way similar to its attitudes in the economic and social welfare fields, thus, applying minimalist and enabling features to its political-economic activities.

Singapore has no formal ties with major advanced nations, such as the United States, but it is highly trusted by them, including also China, towards which it is a model. Hence, Singapore has a stake in the global world, because it is minimalist, so it assumes a low profile, it possesses high defense capacities, and it takes care of its international network relations.³⁶⁴ Singapore's informal relations with the United States have spurred the city-state towards broad diplomatic interactions with other countries of the region, such as China and Taiwan.³⁶⁵ Singapore's security at the diplomatic level is so strong thanks to its ethnic diversity background. This is also the reason why many countries of the region emulate this tiny city-state. Indeed, it could transform a possible vulnerability into a diplomatic strength. For example, many Singaporean political leaders are Chinese, and, traditionally, its foreign minister is of Indian or Malay origin. Moreover, Singapore could fortify neighbours' trust thanks to its "ASEAN first" policy, being one of the ASEAN founders together with Indonesia, Malaysia, Thailand and the Philippines.³⁶⁶

This dual status as a state and as a city gives to Singapore smart city-state important assignments for what concerns multiple areas, such as the environment, transportation and urban logistics, energy, etc. Through its ministries and boards, Singapore is able to confront in a holistic, dynamic and authoritative way the 21st century challenges. This is what makes Singapore smart, and it is also why it is a model to follow, in particular to China.

³⁶³ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., pp. 94-97

³⁶⁴ Ivi, pp. 98-99

³⁶⁵ Ivi, pp. 101-102

³⁶⁶ Ivi, p. 103. See also Centre for International Law (CIL) National University of Singapore. (2019, August 20). An introduction to ASEAN, *Centre for International Law (CIL) National University of Singapore*. Retrieved from: <https://cil.nus.edu.sg/research/asean-law-policy/topics/asean-resources/an-introduction-to-asean/>

3.5 Singapore as a sustainable model (for China)

As it has been already asserted in the previous chapters, urbanisation, in addition to other urban problems, such as transportation, energy and waste management, water supply and environmental quality, spurs urban centres to re-transform themselves in order to meet the demands imposed by the increasingly rapid urbanisation.

Large developing countries, such as China and India, take an interest in Singapore's model thanks to its smart urban logistics. In particular, Singapore's urban planning policies are of interest to many nations, because they are dynamic and holistic in their nature. As a tiny city-state, the Lion City is able to behave both as a city and as a state, thus, national government is closely linked to local government, and this close partnership facilitates rapid responses to urban challenges.³⁶⁷

Furthermore, Singapore is also part of major organisations, such as the UN, and major city networks, such as the C40; this is also due to its diminutive size and its flexible and dynamic urban policy.³⁶⁸

Moreover, according to the UN World Urbanisation Prospects, cities of modest dimensions, such as Singapore, will double and will host at least 400 million people by the end of 2040.³⁶⁹ These urban forecasts demonstrate to what extent Singapore is considered a far-reaching model. The city-state is, indeed, a global hub, in that it is a global laboratory for technological solutions, it creates innovative infrastructures, it attracts foreign investment, it exports knowledge to the broader world. It has rapidly transformed from a labour-intensive model to a knowledge-intensive one.³⁷⁰

The Singaporean model is expanding beyond the Southeast Asian region; indeed, countries such as South Korea, India and Russia are emulating the city state, as stated by Calder.³⁷¹ Concerning South Korea, primarily it is focusing on Singapore's innovative

³⁶⁷ Ibid

³⁶⁸ United Nations (UN). Member States. Retrieved from: <https://www.un.org/en/about-us/member-states#gotoS>. See also C40 Cities. Our Cities. Retrieved from: <https://www.c40.org/cities/>

³⁶⁹ United Nations Department of Economic and Social Affairs (UNDESA). (2014). World Urbanisation Prospects: The 2014 Revision, op. cit., 13. See also Calder, K. E. (2016). *Singapore: Smart City Smart State*, Washington, D.C.: Brookings Institution Press, p. 150

³⁷⁰ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 134

³⁷¹ Ivi, pp. 156-158

development in infrastructures and technologies. South Korea is following Singapore in the development of a port industry in order to improve national economic progress. Busan Port, the largest port of Korea, is indeed trying to become a world-class port pushed by the PSA example.³⁷² In India, instead, Intergovernmental Organisations (IGOs), such as the Asian Development Bank, in partnership with the Temasek Holdings, have supported the development of enterprises; for example, Singapore has spurred the creation of the International Technology Park Bangalore.³⁷³ In addition, it has undertaken a project of urban management together with the government of Kerala with a focus on wastewater management and recycling. Further Indian interests in the city-state are the port management and the network infrastructure establishment.³⁷⁴ For what concerns Russia, it emulated Singapore in the development of Sochi International Airport opened in 2014, while also adopting green and smart solutions in certain areas, such as at Innopolis, a recent techno park.³⁷⁵

The Singapore model acquired credibility thanks to its smart, attractive, green and innovative technologies, which could increase economic development more rapidly.³⁷⁶ Singapore is continuously striving for improving more and more. It has already operated very efficiently in order to become a global hub, and foreign spectators have always seen it as a model to follow.

China is one of its first followers for what concerns urban sustainability learning and, also, it established a close political and economic cooperation with Singapore. This tight alliance dates back to 1978, when Deng Xiaoping visited Singapore; since then, relationships have tightened until providing Singapore's support towards China during the years.³⁷⁷ An example of this tight alliance is the project of the Sino-Singapore Tianjin Eco City in China. The flow of Singapore expertise towards China represents an opportunity for Singapore to be recognized worldwide. Indeed, as abovementioned, a vast number of countries have emulated this city-state. Four main projects, including the

³⁷² Ivi, p. 156

³⁷³ Ivi, p. 157

³⁷⁴ Ibid

³⁷⁵ Ivi, p. 158

³⁷⁶ Ivi, pp.158-161

³⁷⁷ Ivi, p. 151. On Deng Xiaoping's visit to China and further relationship developments with Singapore, see also Vogel, E. F. (2011). *Deng Xiaoping and the Transformation of China*, Cambridge: The Belknap Press of Harvard University Press, pp. 290-291

Tianjin Eco-City, have been developed in China thanks to Singapore's partnership: the manufacturing-oriented Suzhou Industrial Park, the Tianjin Eco-City (Eco-urban development), the knowledge-based economy-oriented Guangzhou Knowledge City and the Chongqing Connectivity Initiative (IoT).³⁷⁸

These projects all have the aim of encouraging innovation in China. For example, the Suzhou Industrial Park aims at attracting high-tech industries, while motivating entrepreneurship and ICT programs. Indeed, a variety of multinationals, such as Samsung, UPS and Motorola, have invested there.³⁷⁹ This is only one example, but also the other three projects demonstrate that Singapore and China have a lot to share. This is therefore one of the reasons why Singapore is constantly ranked high in global surveys, such as those of the World Bank and the World Economic Forum. It is truly a model for the entire international community.³⁸⁰

China's necessity of transforming the country into a low-carbon, sustainable area with eco-city and eco-industrial park projects derives from its negative performances in terms of damage to the environment due to pollution and scarcity of water resources, air pollution, land pollution, effects of climate change, etc. caused by the rapid economic development of China since 1979. China asked for help to many developed countries of the West, such as the United States, Germany, France, Britain, and so forth. Nevertheless, China saw in Singapore its perfect bilateral partner, as a model for sustainable urban development.³⁸¹ Indeed, China aspired to achieve Singapore's outcomes, since the island could shift itself from a Third World country to a First World leading global hub power in a few years. Singapore reached this position according to two versions, namely its own view of being a model for other Asian cities, and also Asian leaders' sharing of this view.³⁸²

China considers Singapore as an urban and economic model at first. The reason can be found into the city-state's controlled and regulated urban development. Indeed, urban development plans have always been implemented regularly, avoiding planning problems

³⁷⁸ Ivi, pp. 152-156

³⁷⁹ Ibid

³⁸⁰ Ibid

³⁸¹ Curien, R. (2017). Singapore, a Model for (Sustainable?) Urban Development in China. An Overview of 20 years of Sino-Singaporean Cooperation, op. cit., p. 25

³⁸² Ivi, p. 26

that sometimes could arise from governmental action. One of its strengths is the creation of integrated industrial and residential communities, which enable neighbourhoods to become focal points for economic development. The combination of infrastructure development and high quality of the utilities it provides to the city, such as roads, heating, cleaning, gas and electricity, telecommunications, are of interest to many foreign cities. This is also why Singapore attracts so many FDI and, by consequence, the supply of jobs remains high. Moreover, the technological innovation, which could be developed thanks to the cooperation of other industrialised nations, represent one of the main features of the island. The development into a Garden City gives to Singapore the award of sustainable city, even if it still has steps to take in tackling its high energy consumption and fossil fuel utilisation.³⁸³ These aspects will be treated in detail in the following chapter.

Since Singapore is a model for urban development, China chose it, also because both countries share quite the same culture (indeed, the majority of Chinese ethnicity in Singapore numbers about 70% of the total population) and the same socio-political system (both countries are governed by a single authoritarian party with hegemonic rule). To this end, Singapore is the foreign country which is more likely to invest in China for the development of eco-industrial urban projects. The very first urban projects in China started in the 1990s.³⁸⁴

3.5.1 Sino-Singapore Tianjin Eco-City

In 2007, the governments of China and Singapore launched the cutting-edge urban project of the Sino-Singaporean Tianjin Eco-City (SSTEC). This project is oriented towards ecology; indeed, its principal aim is to reduce energy use through new technologies for recycling resources under the Singaporean influence.³⁸⁵

The location was set under two Chinese requests: the area should be a non-arable land zone in order to preserve agriculture, and also it should be in a site of water scarcity. A zone in the municipality of Tianjin was finally selected, since that place has a strategic

³⁸³ Ivi, pp. 26, 27

³⁸⁴ Ivi, pp. 27-28

³⁸⁵ Ivi, p. 30

location. It is placed in the midst of a large urban area near Beijing, best known as the major economic centre of northern China.³⁸⁶

The Tianjin Eco-City is administered by an *ad hoc* administrative entity, the Sino-Singapore Tianjin Eco-City Administrative Committee (SSTEC-AC). The project is directly controlled by a Joint Steering Council under the Chinese and Singaporean Vice-Premiers whose aim is to decide the strategic goal of the project; in addition, a Joint Working Committee under the Chinese Ministry for Urban Development and the Singaporean Ministry for National Development supervises the project. Both administrations aim at ensuring a good-quality urban planning, environmental protection, resources conservation, waste and water management, high-quality standards of living. These goals are jointly reached through the expertise of the Singaporean leading agencies, namely the URA, the HDB, the BCA, the National Environment Authority (NEA), the Singapore's National Water Agency, the so-called Public Utilities Board (PUB), the Land Transport Authority, and the International Enterprise Singapore (IES). Furthermore, about ¥30 billion have been spent in the overall project. Three leading organisations oversaw the eco-city project, namely the Chinese Urban Planning Academy, the Tianjin Urban Planning Institute, and the Singaporean URA.³⁸⁷

Finally, the Tianjin Eco-City project's aim was to build a city of 350.000 inhabitants and 210.000 job employments within a surface of 34,2 km² by 2020.³⁸⁸

Even though environmentalism in China is not the priority, since rapid urban and economic development on a large scale are the major concerns for the Chinese authorities, the Sino-Singaporean partnership aims at paying greater attention to energy use and environmental sobriety and quality. In particular, major attention is paid to the local production of renewable energy (which should provide 20% of energy in the eco-city), such as solar, wind or geothermal, the reuse of resources, such as waste water (the project involves non-conventional water supply systems, such as desalinated seawater and reuse of rainwater) and solid waste (recycling has become a priority for SSTEC authorities, and waste collection systems have been implemented), and to the greenery, thanks to the contribution of Singapore's urban planning. The reasons are basically two: these sustainable facilities help the ecosystem preserving soil quality and biodiversity, while

³⁸⁶ Ibid

³⁸⁷ Ibid

³⁸⁸ Ibid

also guaranteeing a high quality of life for the citizens. Furthermore, the SSTEAC is original in China since it has a system of quantitative indicators, the Key Performance Indicators (KPIs), which is the result of a joint coordination between the Singaporean and Chinese expertise through the oversight of the SSTEAC-AC in order to indicate periodically their precise aims and results. This is the only eco-city project in China that presents the KPIs.³⁸⁹



Figure 7. Sino-Singapore Tianjin Eco-City Project

According to the scholar Federico Caprotti, eco-city projects worldwide are increasing more and more. In 2013, 100 eco-city projects were underway in China. Eco-city concept is currently one focal point in the field of sustainability. Indeed, these projects have become an important objective of researchers, not only in environmental debates, but also in economic and technological development of cities. To this end, eco-cities see the involvement of entrepreneurial states, as Singapore in this case, and capital in the urban environment design.³⁹⁰

³⁸⁹ Ivi, pp. 31-35

³⁹⁰ Caprotti, F. (2013, August 12). Critical research on eco-cities? A walk through the Sino-Singapore Tianjin Eco-City, China, In *Cities*, Elsevier, p. 1

CHAPTER IV

Climate Action Plan

The following and concluding chapter goes deep into detail about Singapore's Climate Action Plan, the most recent climate plan concerning Singapore's goal of reducing CO₂ emissions by 2030, enhancing efficiency in every sector, from the industrial one to the building, transportation, household, water and waste ones.³⁹¹

Singapore is an active member of the international community; therefore, it is committed to implement key strategies and actions in order to face environmental problems. The Climate Action Plan highlights such long-term policies, which in turn designed Singapore's first NDCs. Singapore's commitment towards climate change starts with this plan, which also refers to the LEDS outlined in the document entitled "Charting Singapore's Low Carbon and Climate Resilient Future".³⁹²

In the paragraphs below, key points of the Climate Action Plan are highlighted. First of all, Singapore's transformation from a polluting and highly industrialised city to a Garden City is described, with a focus on the economic nationalism policy the city is following to achieve its goals. Moreover, the main points covered in the plan are analysed in detail, namely energy, transportation management, carbon emissions reduction, and water management. These are related to every sector mentioned above. Along these lines, various problems and opportunities in the process towards sustainability arise, such as water scarcity and quality, land challenge, biodiversity and green management. Ultimately, Singapore's commitment towards Agenda 2030 is pointed out through an analysis of four SDGs for which it is pledged, namely Goal 11 - to make cities and human settlements inclusive, safe, resilient and sustainable, Goal 13 - to take urgent action to combat climate change and its impacts, Goal 6 - to ensure availability and sustainable management of water and sanitation for all, and Goal 14 - to conserve and sustainably use the oceans, seas and marine resources for sustainable development.³⁹³ That

³⁹¹ Strategy Group Prime Minister's Office, National Climate Change Secretariat. (2016). *Singapore's Climate Action Plan. Take Action Today, for a Carbon-Efficient Singapore*, op. cit., p. 2

³⁹² Strategy Group Prime Minister's Office, National Climate Change Secretariat. (2020). *Charting Singapore's Low Carbon and Climate Resilient Future*, op. cit., p. 1

³⁹³ United Nations General Assembly (UNGA). (2015, September 25). *Transforming our world: the 2030 Agenda for Sustainable Development*, op. cit.

considered, Singapore is undertaking Agenda 2030 SDGs considering the urgent need for collaborative action during a delicate moment like the one we are facing today.

4.1 Singapore's transformation into a Garden City: from Economic Nationalism to Climate Action Plan

Climate-related problems, as already mentioned, are a long-lasting concern at the global level. A number of initiatives have been taken in order to fight climate change, or, at least, in order to reach a temperature level adequate for the liveability on this planet. Nevertheless, during these years, there has been an inappropriate commitment from different countries to the effort established to mitigate climate change. One of the reasons of this statement is related to different national interests among nation-states.

Summarizing the above, economic nationalism of mercantilist type is one of the causes of this unsuccessful operation by nation-states to try to adopt measures to mitigate and to adapt to climate change.³⁹⁴

Between the end of the 20th century and the beginning of the 21st century, a new approach to economic nationalism emerged. The literature on this regard aims at establishing a connection between states' interests and international problems. Indeed, this new approach pushes for new policies of free trade, foreign investment and adaptation to globalisation. Even if national interest remains the primary goal of the nation-states, there is also more emphasis on other states and non-states actors' behaviour. Nowadays, collaborative steps must be taken into account in order to overcome global problems. To this end, national commitments to achieve higher environmental standards are to be considered positively.³⁹⁵

This new economic nationalist approach appears to provide a realistic scenario of the contemporary world.

The case of Singapore is quintessential in this respect. In Singapore, the "economy first" policy has always prevailed since the advent of the self-governance period (1959), because it suffered a moment of high unemployment rate (5%), corruption, crime, decline in public housing, decrease in economic growth (deficit of US\$4.7 million), and rapid urbanisation. Hence, the priority at that time was economic growth, more specifically "economic survival", as asserted by the scholars Sajid Anwar and Choon-Yin Sam.³⁹⁶

³⁹⁴ Anwar, S. & Sam, C.-Y. (2012, March). Is Economic Nationalism good for the Environment? A case study of Singapore, In *Asian Studies Review*, *Routledge*, pp. 39-43

³⁹⁵ Ivi, p. 43

³⁹⁶ Ivi, p. 45

According to the IMF World Economic Outlook Database, Singapore was one of the major annual emitters in terms of CO₂ per capita release. In the period between 1990 and 2005, CO₂ emissions averaged 14.26 metric tons per capita, meaning that Singapore ranked as the 33rd major emitter of GHG amongst 215 countries.³⁹⁷ The reason of this bad prospective was that Singapore spurred for economic development and urbanisation in order to survive to external challenges. Nevertheless, Singapore is too small to figure out globally in terms of environmental impact (it accounts for only 0.2% of global CO₂ emissions).³⁹⁸ Anyway, today the city-state is trying to maximise its environmental standards every year through Green and Climate Plans. Indeed, different institutions, with the help of the government, have been working on several methods for energy efficiency and green technologies implementation. Singapore economic approach fits into the new economic nationalist paradigm, since along the years its environmental policy has shifted from denying emissions reduction obligations to the entry into force of plans focused on CO₂ limitation.³⁹⁹ Moreover, according to Lee Kuan Yew, Singapore's position towards CO₂ emissions reduction would not commit the city to reduce its emissions unless other countries would not do the same, based on economic reasons. Here, it is clear the new economic nationalist paradigm at work, according to which Singapore aims at benefitting for itself if also others benefit from something. Of course, it is clear that Singapore wants to maintain a good international reputation and, in addition, it wants to boost its economic growth.⁴⁰⁰

Actually, the problem of environmental degradation must be felt both at national and global level, so that there must be a reconciliation between national and international interests. A win-win situation is what is needed in order to face global problems, and the new approach to economic nationalism has precisely this objective.⁴⁰¹

³⁹⁷ Ivi, p. 46. See also International Monetary Fund (IMF). (2008, October). World Economic Outlook Database, *International Monetary Fund (IMF)*. Retrieved from: <https://www.imf.org/en/Publications/>

³⁹⁸ Ivi, p. 49

³⁹⁹ Hamilton-Hart, N. (2006). Singapore's Climate Change Policy: The limits of learning, *Contemporary Southeast Asia*, 28:3, p. 372

⁴⁰⁰ Anwar, S. & Sam, C.-Y. (2012, March). Is Economic Nationalism good for the Environment? A case study of Singapore, op. cit., p. 50. See also Ho, A. (2009, October 30). Reasons for Singapore to be cool on global warming, *The Straits Times*, Retrieved from: <https://eresources.nlb.gov.sg/newspapers/>

⁴⁰¹ Ibid

In accord with this new economic nationalist method, Singapore adopted in 2016 the Singapore Climate Action Plan. Its major goal is to obtain a carbon-efficient Singapore by 2030, reducing emissions by 36% below 2005 levels and stabilising them by 2030.⁴⁰²

Singapore aims at setting out four strategies concerning emissions reduction, namely improving energy efficiency, reducing carbon emissions from power generation, developing low-carbon technologies, and mitigating carbon emissions through the collective action of government and its related agencies, citizens, businesses, and the community as a whole.⁴⁰³

Singapore feel with pressure climate change problems, since its small size, high urbanisation trends and lack of natural resources present serious difficulties to the city-state in pursuing other energy options, such as nuclear, hydro-electric, wind or geothermal power. Anyway, Singapore founded alternative ways to reduce emissions. For example, it switched from fuel oil to natural gas (which is polluting, but to a clearly lower level since it is the cleanest form of fossil fuel) for energy generation. According to the Climate Action Plan, today about 95% of power generation comes from natural gas.⁴⁰⁴

Senior Minister and Coordinating Minister for National Security Teo Chee Hean, Chairman of the Inter-Ministerial Committee on Climate Change (IMCCC), during the National Climate Change Competition Award Ceremony of 2015 asserted:

Singapore plans to further reduce our emissions intensity as part of international efforts to address climate change. For a very small country with limited alternative energy options, the stabilisation of our emissions with the aim of peaking around 2030 requires serious efforts by everyone. We have to strive for higher levels of energy efficiency, including deployment of best-in-class technologies.⁴⁰⁵

Singapore is supporting and contributing every year to multilateral negotiations under the UNFCCC. On 3 July 2015, Singapore submitted its pledge for COP21, ranking as

⁴⁰² Strategy Group Prime Minister's Office, National Climate Change Secretariat. (2016). *Singapore's Climate Action Plan. Take Action Today, for a Carbon-Efficient Singapore*, op. cit., p. 2

⁴⁰³ Ibid

⁴⁰⁴ Ivi, p. 4

⁴⁰⁵ Deputy Prime Minister Teo Chee Hean at the National Climate Change Competition Award Ceremony 2015. See Strategy Group Prime Minister's Office, National Climate Change Secretariat. (2016). *Singapore's Climate Action Plan. Take Action Today, for a Carbon-Efficient Singapore*, Singapore: Strategy Group Prime Minister's Office, National Climate Change Secretariat, p. 6

number 17th amongst submitting countries. Thus, this emphasises Singapore's commitment towards sustainability at global level.⁴⁰⁶ This is the result of the necessity to survive to climate change in the first place, since this tiny city-state, as an island, faces the threat of rising sea level due to global warm. In 2015, the Centre for Climate Research Singapore (CCRS), in partnership with United Kingdom's Met Office Hadley Centre, conducted a study in Singapore, the Second National Climate Change Study; during phase 1 of the study, it reported that temperatures in Singapore will rise importantly, storms will be more frequent and heavier, and sea level will rise up to 2100 in the long-run.⁴⁰⁷ Furthermore, daily mean temperatures in Singapore are projected to increase notably: from 1.4°C to 4.6°C by the end of this century (studied period of time: 2070-2099). According to Singapore's government science advisors, from 1950s Singapore's temperature has increased of about 0.25°C every decade, accounting for the double of the average trend in the rest of the planet.⁴⁰⁸ Singapore, with a warm and humid climate, has always based its development on the widespread and intensive use of air conditioners. Nevertheless, air conditioners demand is going to increase in the long-term due to the rise in temperatures, thus, the city-state, threatened by the climate crisis, tries alternatives. Green buildings are the new way of contrasting climate change. South Beach, for example, is a complex of offices and shops in the centre of Singapore; it is a modern building designed properly for tropical weathers. The vast aluminium and steel rooftop around the building generates shade and cool. Nowadays, in order to achieve sustainable standards, Singapore needs to build 100% green buildings capable of exploiting natural resources, such as wind and solar energy.⁴⁰⁹ In 2012, the natural park "Gardens by the Bay" has been inaugurated in the Singapore waterfront. It is built on land cleared by the sea and it has become the emblem of the urban renewal of the city-state. The park comprehends 101 hectares of public gardens in the Singapore city centre. The major attraction into the Gardens by the Bay is the Super-tree. The park hosts 18 super-trees, which aim is to create vertical gardens with more than 200 different plant species, in

⁴⁰⁶ Ivi, p. 9

⁴⁰⁷ Centre for Climate Research Singapore (CCRS). (2015). Singapore's Second National Climate Change Study, *Centre for Climate Change Research Singapore (CCRS)*. Retrieved from: <http://ccrs.weather.gov.sg/publications-second-national-climate-change-study-science-reports/>

⁴⁰⁸ Vasagar, J. (2021, November 12). Singapore: Freddi Tropici, *Internazionale*, 1435, p. 72-75

⁴⁰⁹ Ibid

particular orchids, ferns, vines. Super-trees present a concrete base embedded on a steel shell, which in turn is covered by vegetation. Super-trees present various functions, amongst others lighting created through solar panels energy (the same procedure of trees' chlorophyll photosynthesis), and irrigation created through a system of rainwater collection (the same process of trees' rainwater absorption which enables them to grow).⁴¹⁰ Gardens by the Bay's metaphor is to draw Singapore as scientific and rational, meaning that the human will has triumphed over the wilderness, but, at the same time, it gives importance to the strong relationship between the human being and the natural world.⁴¹¹

In addition, sea level is projected to rise between 0,25m and 0,76m during the same period of time considered for temperature forecasts.⁴¹² The long-term consequence could be the flooding of coastal areas, or even the submersion, as sea level rises. For example, a system of geo-bag walls has been created in 2010 by the BCA in order to protect the beach at East Coast Park from shoreline erosion. These bags filled in with sand help preserve the beach from sand erosion due to low or high tides.⁴¹³ Singapore committed to protect its coasts against erosion and flooding. Nowadays, over 70% of Singapore seashore is safeguarded through hard structures, such as geo-bag walls, rock slopes or seawalls. Moreover, from 2011 land must be at least four metres above the mean sea level, as well as roads near coastal areas, in order to protect them from high tides.⁴¹⁴ Terminal 5 of Singapore's Changi Airport will be completed around 2030 and it will be constructed 5,5m above the mean sea level as a precaution against the melting of polar ice.⁴¹⁵ An extreme climate change will increase the necessity to design green architecture able to adapt to natural catastrophes.

Singapore has long been defined the Garden City due to its 3 million planted trees across the island; indeed, trees are a fundamental part of its scenario because they provide cool air from tropical weather. In order to prevent its trees from falling due to heavy rain

⁴¹⁰ Ibid

⁴¹¹ Ibid

⁴¹² Ministry of the Environment and Water Resources & Ministry of National Development. (2016). *Singapore's Climate Action Plan: A Climate-Resilient Singapore, For a Sustainable Future*, Singapore: Ministry of the Environment and Water Resources & Ministry of National Development, pp. 4-5

⁴¹³ Ivi, p. 7

⁴¹⁴ Ivi, p. 12

⁴¹⁵ Vasagar, J. (2021, November 12). Singapore: Freddi Tropici, op. cit.

periods and causing damage to the people, the National Parks Board (NParks) checks trees along the most crowded areas at least once a year in order to ensure their resilience to climate change impacts. Furthermore, Singapore aims at protecting its ecosystem, being home to a large variety of flora and fauna. For example, in 2014 Singapore NParks created its first marine park, an ecosystem inhabited by endangered and rare marine species, at the Sisters' Island. In addition, at Sisters' Islands Marine Park a monitoring system has been established in order to prevent endangered species of marine animals and plants from rising sea surface temperatures (SSTs), cause for ocean acidification, stronger and intense rainfall, rising sea levels, etc. Another important measure established in order to preserve Singapore's biodiversity is to preserve mangrove areas along the island, since the northeastern coastline of Pulau Tekong accounts for 90 hectares of mangrove forests.⁴¹⁶

Concerning food supply, this is another sensitive issue. Basically, Singapore imports more than 90% of its food supply from its neighbouring region, therefore, this can be a problem for Singapore's food supply since low crop levels could affect it, in particular regarding the supply of rice and vegetables, for example. In order to overcome this problem, the Agri-Food and Veterinary Authority of Singapore (AVA) follows a diversification strategy, importing food from different regions. AVA is working hard in order to prevent such shortages, and it is advising local farmers to ensure that they are prepared for climate change disruptions. One solution could be indoor farming technologies. Indeed, at Panasonic Factory Solutions Asia Pacific vegetables, such as lettuce, rocket, red radish, are grown by a special LED-lighting system. This system is totally automated to spur productivity, and hygiene standards are controlled under very strict rules. Other systems could be Closed Containment Aquaculture Systems (CCAS), which enable fishes to be protected from environmental impacts, raising them into an area with treated water. This system enables farmers to boost productivity, while also ensuring water resource efficiency and space optimisation.⁴¹⁷

⁴¹⁶ Ivi, pp. 18-20

⁴¹⁷ Ivi, pp. 23-24

4.2 Singapore's commitment to climate change

Climate change is an urgent concern that needs collaborative efforts in order to be faced. Since Singapore is an active member of the international community, it is committed to do its part at the national level. In particular, it urges need for multinational cooperation following the latest climate change disruptions. The Climate Action Plan, as previously mentioned, outlined the key strategies in order to achieve its first NDCs.

Actually, this is the document which delineates the approach Singapore is adopting in order to face climate crisis, while also explaining in detail its commitment towards lowering carbon emissions. Singapore implemented systematically these strategies, but it recognised that more action is needed in order to survive climate change. Even if it is a small island and its emissions are not very impacting at global level, Singapore aims at achieving a transition to an even greener future, lowering carbon emissions and approaching to a climate resilient future. It recently referred to the LEDS outlined in the document entitled “Charting Singapore’s Low Carbon and Climate Resilient Future”. LEDS has been prepared thanks to the collaboration of government agencies under the IMCCC with the help of experts, citizens and industry. In this respect, Singapore’s ability to include also other parties into the strategical process aims at addressing climate change with a whole-of-nation approach.⁴¹⁸

Singapore’s approach towards the development of its LEDS by 2050 is guided by three dictates: considered, committed and collective. According to this approach, Singapore has achieved important results concerning emissions reduction thanks to the best and most efficient innovative technologies. This is to say that Singapore pushes for economic growth while also achieving its environmental goals. Today, Singapore has notably a lower emission intensity with respect to the beginning of the 21st century, ranking number 20 best out of 141 countries in 2017.⁴¹⁹

⁴¹⁸ Strategy Group Prime Minister’s Office, National Climate Change Secretariat. (2020). *Charting Singapore’s Low Carbon and Climate Resilient Future*, op. cit.

⁴¹⁹ Ivi, p. 2. See also International Energy Agency (IEA). (2019). *CO₂ Emissions from Fuel Combustion*, OECDiLibrary

Singapore's effort may be modest due to its small size, but it could be substantial if it works collectively with all countries in order to reach the long-term Paris Agreement's objective.⁴²⁰

Singapore builds its LEDS on three key pillars: to transform its economy, industry and society, to use innovative technologies, and to participate in international collaborations. Regarding the first pillar, energy efficiency, resource conservation, innovation are the drivers of the new transformation towards a greener economy. Moreover, maintaining a highly competitive advantage in every sector will spur Singapore's economy towards becoming best-in-class in global business. Concerning the second pillar, Singapore is continuously investing in R&D in order to develop new mechanisms for energy and carbon management; this involves developmental technologies, for example, carbon capture, utilisation and storage (CCUS) mechanism and low-carbon hydrogen. For what concerns the third pillar, in order to support environmental restoration, more international collaboration is needed. Thus, Singapore will boost partnerships with other countries in fundamental areas, as carbon storage, energy imports, green economy.⁴²¹

Singapore aims at transforming its key sectors with innovative solutions. The power sector is concentrating on the use of natural gas, solar energy, regional power grids, and net zero-carbon solutions. The progressive decarbonisation process of electricity grids will reduce significantly emissions in the industrial sector, for example. Singapore is supporting sustainable production through new business opportunities. Moreover, another important sector is the building one, since Singapore is a compact city-state. By 2030, it will green 80% of its buildings by GFA. In addition, energy consumption in the household sector is controlled by the Minimum Energy Performance Standards (MEPS) and the Mandatory Energy Labelling Scheme (MELS), which are reviewed regularly in order to maintain energy-efficient measures for households. The waste sector, instead, aims at developing a circular economy in which wastes are recycled in the value chain as long as it is possible. In this regard, Singapore launched the Zero Waste Masterplan and the Resource Sustainability Act (RSA) in 2019 to manage waste production and recycling. In accord with SDGs 2030, Singapore will reduce the amount of waste by 30%

⁴²⁰ Ivi, p. 3

⁴²¹ Ivi, p. 7

by 2030; this will reduce its carbon footprint in order to address the problem of climate change.⁴²²

Moreover, Singapore aims to be a green finance hub in order to facilitate financial flows through low-carbon sectors. Hence, in November 2019 Singapore launched its Green Finance Action Plan, which focuses on detailed strategies to build a resilient financial system with the aim of overcoming environmental risks. One further step in this regard is the carbon tax, which was adopted in 2019 and applies to all sectors. Singapore was the first Southeast Asian country to adopt the carbon tax, which was initially fixed at S\$5/t CO₂. By 2023, it will increase between S\$10/t CO₂ and S\$15/t CO₂. Of course, it is put in place in order to incentivise global emissions reduction. Furthermore, Singapore worked with other ASEAN countries in order to develop the ASEAN Green Bond Standards, a regional green bond market. It also invested the amount of S\$1 billion in R&D for new urban mobility and energy grids; Singapore is totally a global laboratory for innovative and sustainable solutions.⁴²³

Besides regional cooperation, Singapore commits internationally in order to support environmental action. It works under the UNFCCC, for example, but also with the International Civil Aviation Organisation (ICAO) and the International Maritime Organisation (IMO) to reduce carbon emissions in the maritime and aviation sectors.⁴²⁴ This demonstrates the international commitment of this city-state and its interest in finding a solution to climate change. No country can solve this problem alone, indeed, every country must commit to achieve a greener future as under the Paris Agreement. Recently, following COP26 negotiations, world leaders have decided to set out important objectives intended to improve mitigation and adaptation efforts, namely net-zero emissions at global level by 2050 and temperatures increase at a maximum level of 1.5°C as stabilised under the Paris Agreement, the protection of communities and natural habitats, the mobilisation of funding, and international cooperation.⁴²⁵

⁴²² Ivi, pp. 10-12

⁴²³ Ivi, pp. 13-14

⁴²⁴ Ivi, p. 15

⁴²⁵ Chabert, V. (2021, November). La COP26 volge al termine: un bilancio del vertice internazionale sul clima di Glasgow, 10, *Opinio Juris*. Retrieved from: <https://www.opiniojuris.it/la-cop26-volge-al-termine-un-bilancio-del-vertice-internazionale-sul-clima-di-glasgow/>. See also United Nations Climate Change Conference UK 2021. Gli obiettivi della COP26, *United Nations Climate Change Conference UK 2021*. Retrieved from: <https://ukcop26.org/it/gli-obiettivi-della-cop26/>

4.2.1 Energy

Singapore, as like major Asian nations, lacks of energy resources; thus, it is considered the 15th major energy importer on earth.⁴²⁶

Several geographical constraints pose to Singapore a number of challenges: a limited land area, high urbanisation levels, flat land, low wind speeds, no geothermal resources.⁴²⁷ Thus, alternative energy resources represent a necessity for Singapore survival.⁴²⁸

Article 4, paragraph 10, of the UNFCCC states that:

The Parties shall, in accordance with Article 10, take into consideration in the implementation of the commitments of the Convention the situation of Parties, particularly developing country Parties, with economies that are vulnerable to the adverse effects of the implementation of measures to respond to climate change. This applies notably to Parties with economies that are highly dependent on income generated from the production, processing and export, and/or consumption of fossil fuels and associated energy-intensive products and/or the use of fossil fuels for which such Parties have serious difficulties in switching to alternatives.⁴²⁹

This UNFCCC's article recognises the difficulties that some vulnerable countries could face in their transition towards alternative energy resources.

Biomass as a renewable energy is not yet available to be used in Singapore, contrary to many other countries with available land mass. Since Singapore has a limited land area, this alternative use of energy is not functional for the city-state. Actually, Singapore is

⁴²⁶ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 129. See also Central Intelligence Agency (CIA). (2021, November 9). The World Factbook: Singapore, *Central Intelligence Agency (CIA)*. Retrieved from: <https://www.cia.gov/the-world-factbook/countries/singapore/#energy>. This ranking refers to crude oil imports compared to other 260 locations across the globe

⁴²⁷ Ibid

⁴²⁸ Strategy Group Prime Minister's Office, National Climate Change Secretariat. (2020). *Charting Singapore's Low Carbon and Climate Resilient Future*, op. cit., p. 25

⁴²⁹ United Nations Framework Convention on Climate Change (UNFCCC). (1992). Art. 4.10: Commitments, *United Nations (UN)*. Retrieved from: https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf

converting waste into energy through waste management systems, providing to its population 2,3% of electricity demand.⁴³⁰ Similarly, geothermal energy cannot be used in Singapore since there are not conventional geothermal resources available in the island. With a small land cover and no conventional geothermal resources, unconventional geothermal resources cannot be used cost-effectively there through new expensive technologies.⁴³¹ The same happens for hydroelectric and marine power generation, since Singapore is generally flat and less than 15 metres above the mean sea level, presenting relatively calm waters around it, thus undermining the correct use of wave power.⁴³² Nuclear power is on its way to be tested, and it is not yet functional since newer nuclear technologies are at the testing point and not yet operational. Since Singapore is overcrowded and small, risks still outweigh benefits for now. Nevertheless, the city-state will continuously monitor nuclear technology and will keep informed on potential benefits in the long-term.⁴³³ Unfortunately, wind energy is also not viable, since wind speed is too low for the wind required for functional turbines. Moreover, since there is a busy maritime traffic in Singapore's waters, wind turbines are challenging to be used offshore.⁴³⁴ Solar energy is the most viable alternative energy so far. The government is committing to invest in R&D and test-bed solar panels in order to experiment efficient and cost-effective uses of solar photovoltaic deployment. By 2030, Singapore will deploy at least 2GWp⁴³⁵ of solar energy.⁴³⁶ Furthermore, Singapore is taking advantage of natural gas, which has been already mentioned in the chapters above. In particular, liquefied natural gas (LNG) represents the most energy-efficient, cost-effective and environmentally friendly option for a little city-state with no geothermal, wind, marine, and nuclear power. The majority of this gas is used in the electric-power sector. In 1999, Singapore decided to set aside some parts of land to create a gas terminal. Later on, in 2006, the government announced its will to import gas in order to meet future energy

⁴³⁰ Strategy Group Prime Minister's Office, National Climate Change Secretariat. (2020). *Charting Singapore's Low Carbon and Climate Resilient Future*, op. cit.

⁴³¹ Ibid

⁴³² Ibid

⁴³³ Ibid

⁴³⁴ Ibid

⁴³⁵ GWp refers to Gigawatt-peak produced by each solar cell

⁴³⁶ Strategy Group Prime Minister's Office, National Climate Change Secretariat. (2020). *Charting Singapore's Low Carbon and Climate Resilient Future*, op. cit., p. 26

demands, and also to build its first gas terminal, while, at the same time, it also diversified its natural gas' sources to produce it. In 2014, the first Singaporean gas terminal was opened in Jurong Island. At that occasion, PM Lee announced that there was another project of building a second gas terminal, which will be operational by 2025 or 2030.⁴³⁷ Nowadays, Singapore is becoming Asia's trading hub for LNG, and it is exporting to countries such as China, Japan and Korea, major gas importers. The creation of an LNG trading hub will enhance Singapore's national security in the field of energy and its competitiveness at regional and global level.⁴³⁸

According to the document "Charting Singapore's Low Carbon and Climate Resilient Future", Singapore will strongly commit to ensure a sustainable energy supply for all. It will exploit the "Four Energy Switches" to overcome its energy challenges. First of all, natural gas will be the key to alternative power generation, since it takes time to develop other energy sources different from fossil fuel. Furthermore, Singapore launched the Energy Efficient Grant Call to spur companies to invest in energy-efficient technologies in order to lower emissions. Secondly, the switch to solar energy is the second most viable way for Singapore. The SolarNova programme has been implemented in the public sector in order to boost solar photovoltaic adoption, together with energy storage systems (ESS) and solar energy forecasting systems to mitigate the variability of solar power due to variable weather conditions in Singapore. Thirdly, the city-state is experimenting regional power grids which provide energy in a cost-effective way, in addition to regional partnerships; for example, the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project is a regional grid which could provide new alternative energy options that, instead, may be unavailable to be implemented in Singapore's soil. Fourthly, Singapore is studying new low-carbon technologies to decarbonise the power sector, as like the deployment of low-carbon hydrogen.⁴³⁹

⁴³⁷ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., pp. 129-130. See also Hui Hong, C. & Al-Rikabi, R. (2014, February 25). Singapore Bids for Role as LNG Hub with Second Terminal, *Bloomberg News*. Retrieved from: <https://www.bloomberg.com/news/articles/2014-02-25/singapore-plans-to-build-second-lng-terminal-in-country-s-east>

⁴³⁸ Ibid

⁴³⁹ Strategy Group Prime Minister's Office, National Climate Change Secretariat. (2020). *Charting Singapore's Low Carbon and Climate Resilient Future*, op. cit., pp. 40-44

Senior Minister of State for the Environment and Water Resources Amy Chor, at the Opening Ceremony of the National Energy Efficiency Conference on October 6, 2015, stated: “Given Singapore’s reliance on imported energy and the limited options for alternative energy, improving energy efficiency is a key strategy that Singapore has adopted to mitigate our GHG emissions, improve energy competitiveness and security.”⁴⁴⁰

Therefore, energy efficiency is a fundamental objective for Singapore in order to reduce carbon emissions in all sectors, namely industry, buildings, transport, household, water and waste, and to meet UN SDGs goals by 2030.

4.2.2 Transportation

Transportation management in Singapore is both a challenge and a benefit. Since the city-state has a high population density clustered in a relatively small area, energy and environmental challenges are daily occurrence. Rapid urbanisation led to an ever-increasing number of automobiles circulating along the roads. Of course, this trend is neither efficient in economic terms nor environmentally sustainable. As a consequence, Singapore’s government decided to minimise the use of private automobiles as part of its urban planning, and it pushed for increasing pedestrians and bicycle viability, especially along the main roads.⁴⁴¹

Transportation management is efficient in Singapore mainly for two reasons: the public transportation network is well-connected and it is measured through traffic control systems updated with the latest technologies. The transportation system is divided into two typologies: the mass rapid transit (MRT), and the light rapid transit (LRT), in addition to public buses and taxis.⁴⁴² The transport system is the one for which Singapore invests

⁴⁴⁰ Senior Minister of State for the Environment and Water Resources Amy Chor at the Opening Ceremony of the National Energy Efficiency Conference on October 6, 2015. See Strategy Group Prime Minister’s Office, National Climate Change Secretariat. (2016). *Singapore’s Climate Action Plan. Take Action Today, for a Carbon-Efficient Singapore*, Singapore: Strategy Group Prime Minister’s Office, National Climate Change Secretariat, p. 25

⁴⁴¹ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., pp. 117-118

⁴⁴² Ibid. See also Land Transport Authority (LTA). Retrieved from: <https://www.lta.gov.sg/content/ltagov/en.html>

more. For example, the first MRT lines constructed in 1982 cost about S\$5 billion.⁴⁴³ Yet, despite investments' costs are high, transportation's prices remain low. MRT and LRT lines are low priced in comparison with other transportation services in other cities all over the world. These pricing policies spur Singaporeans to take the bus, or the subway, as their preferable way of transport. As like in other metropolis, a smart card (Ez-Link) encourages public transit even more.⁴⁴⁴

Singapore's government established three transportation management concepts in order to discourage private vehicles usage, namely the Vehicle Quota System (VQS), the Area Licensing Scheme (ALS) and the Electronic Road Pricing (ERP) System. Concerning VQS, car owners must require a ten-year certificate, called Certificate of Entitlement (COE), and to pay an annual tax which depends on their car's engines capacity. The COE price discourages the owners of older and more pollutant vehicles, according to the Carbon Emissions-based Vehicle Scheme (CEVS). In addition to this, vehicle owners must pay a registration fee of S\$140, another registration fee which equals the market value of their vehicle, an excise of 20% the original market value, and a tax on goods and services of 7%. ALS, instead, was created in 1973. It was the first charging system for cars which drove into congested urban areas and during central hours. This system was not efficient, since it was manual and it took time to adjust road prices depending on the district and on congestion hours. Therefore, it was substituted with ERP. ERP is electronic and technologically advanced thanks to the implementation of new transponders inserted into vehicles. Vehicles are thus monitored through gantries situated in the most congested parts of Singapore. This system differs from the previous one, because it differentiates tariffs according to the vehicle type, time of day, and area where the vehicle is located.⁴⁴⁵

According to the Climate Action Plan, LTA promotes public transport use during central hours, as well as walking and cycling for shorter destinations, from an overall 66% in 2015 to 75% by 2030. The long-term objective is to achieve 85% of this share by 2050. Furthermore, the implementation of EVs is already under way in the island; a car-sharing programme with EVs has been applied, and public charging infrastructure will increase up to 28.000 by 2030. As already asserted in the previous chapter, NTU is developing

⁴⁴³ Ho, S. (2013, November 5). Mass Rapid Transit (MRT) System, *Singapore Infopedia*. Retrieved from: https://eresources.nlb.gov.sg/infopedia/articles/SIP_2013-11-05_131443.html

⁴⁴⁴ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 118

⁴⁴⁵ Ivi, p. 119

autonomous electric buses with an artificial intelligence system created by NTU engineering students.⁴⁴⁶ By 2040, Singapore will establish a Walk-Cycle-Ride (WCR) mobility plan in order to push people to use these transport modes as their preferred ways of transport. Furthermore, the rail network will increase from 230 km in 2017 to 360 km by 2030, with the possibility to reach the rail station within ten minutes walking from the majority of households. Major green advancements have been made also in the aviation and maritime sectors. Changi Airport has adopted electric baggage vehicles with the respective charging points, while the PSA and Jurong Port installed solar panels and other electrification systems in their port terminals. The project of concluding the new Tuas Port terminal by 2040 represents Singapore's will to be energy-efficient through 1000 automated EVs implementation with a carbon footprint 25% lower than conventional vehicles.⁴⁴⁷

4.2.3 Carbon

As it is mentioned above, increasing carbon efficiency in all sectors is a crucial point in order to maintain Singapore's pledge of reducing emissions intensity by 36% from 2005 levels by 2030. Sectors vary from the industrial one to buildings, transportation, household, water and waste.⁴⁴⁸

In order to set carbon emissions reduction in the above areas, a strong commitment between Singapore's government, its agencies and citizens is necessary. In addition to this, Singapore is part of the international community, and it takes part actively in the global system through its active participation in international negotiations. It encourages collective climate action locally, bringing sustainability issues to school, and internationally, exporting its knowledge and expertise to the rest of the world.⁴⁴⁹

The Climate Action Plan aims at developing collective awareness on GHG emissions reduction, outlining the importance of deploying new strategies in order to reduce them.

⁴⁴⁶ Strategy Group Prime Minister's Office, National Climate Change Secretariat. (2016). *Singapore's Climate Action Plan. Take Action Today, for a Carbon-Efficient Singapore*, op. cit., p. 19

⁴⁴⁷ Strategy Group Prime Minister's Office, National Climate Change Secretariat. (2020). *Charting Singapore's Low Carbon and Climate Resilient Future*, op. cit., pp. 52-59

⁴⁴⁸ Strategy Group Prime Minister's Office, National Climate Change Secretariat. (2016). *Singapore's Climate Action Plan. Take Action Today, for a Carbon-Efficient Singapore*, op. cit., p. 11

⁴⁴⁹ Ivi, pp. 41-50

It is doing this through energy-efficiency and power-efficiency improvements. New technologies are on their way to be designed and tested, and these measures aim at reducing energy costs for businesses and households at the same time, while also reducing emissions. In the long-run, the objective is to achieve economic and environmental benefits for all. Clean and efficient energy, green buildings and clean transportation are some of the keys to address climate change.⁴⁵⁰

Singapore's government is continuously working in partnership with businesses in order to build green and clean technology industries with the long-lasting aim of reducing carbon emissions to the level forecasted.⁴⁵¹

During COP26 negotiations, Singapore announced that it will join the Powering Past Coal Alliance, a coalition of national and sub-national governments, businesses and organisations working to advance the transition from unlimited coal energy to clean energy production, to phase out unabated coal (whose carbon emissions are not captured and stored) from its electric mix by 2050. During COP26, Singapore took the active role of co-facilitator in finalising rules on how countries can reduce their carbon emissions using International Carbon Trading markets, part of Article 6 of the Paris Agreement. Article 6 outlines the creation of an international carbon market (a cross-country emissions trading scheme) to assist states in achieving emissions reduction targets. Its role has been to listen to and bring forward solutions from multiple countries on the creation of this market. Singapore has been chosen for its reputation as an honest and fair mediator in international arenas, a role it has never taken for granted.⁴⁵²

4.2.4 Water

Water is a fundamental resource for the human condition and, at the same time, it is under pressure due to population increase and economic growth. For Singapore, the water sector is delicate, since water scarcity has always led the island-state to import it from the neighbouring Malaysia. Nowadays, water demand is leading the city-state to design

⁴⁵⁰ Ibid

⁴⁵¹ Ibid

⁴⁵² Bertoli, C. (2021, December 21). Il ruolo di Singapore alla COP26, 11, *Opinio Juris*. Retrieved from: <https://www.opiniojuris.it/il-ruolo-di-singapore-alla-cop-26/>. See also Paris Agreement. (2015, December 21). Art. 6. Retrieved from: https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf

innovative and holistic technologies in order to meet the population's demand, such as recycling, catchment, and high-tech retreatment. Internationally, Singapore's water sector is considered nowadays a strategic growth sector due to its innovative expertise and policies. For example, Singapore penalises the excessive use of water with tariffs both for homes and businesses. Furthermore, at Changi International Airport, rainwater is collected through different points in order to reuse it, in particular from runways, turfed areas and roofs of buildings.⁴⁵³

The various water-supply innovative policies owe to the key role of the PUB, which was founded in 1963 with the aim of focusing on ensuring a sustainable water supply in Singapore. Since 2000s, after the breakdown of water negotiations with Malaysia, the PUB gained more responsibility on the issue.⁴⁵⁴ The PUB pursued the so-called "four-tap strategy", highlighting the four most important measures, namely local collection, recycling, desalination and water imports. These four measures helped Singapore to meet both the supply and demand side of the population. PUB, through this strategy, stressed the importance of limiting the use of water, while also encouraging people to jointly manage the water concern through its 2006 Active, Beautiful, Clean (ABC) Programme, to which was awarded the 2013 Global Water Award.⁴⁵⁵ This programme aims at transforming Singapore's canals and reservoirs into beautiful rivers, lakes and streams to be integrated with the surrounding parks and green spaces. This initiative was created in order to increase Singaporeans quality of living, but also to bring people closer to water, and to raise their awareness on this issue. Within this programme, about 100 places have been selected to implement the ABC Waters by 2030.⁴⁵⁶ NEWater is another innovative

⁴⁵³ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 126

⁴⁵⁴ Ivi, p. 127

⁴⁵⁵ Ibid. On the Active, Beautiful, Clean Programme see Singapore's National Water Agency (PUB). (2020, November 23). Active, Beautiful, Clean Waters Programme, *Singapore's National Water Agency (PUB)*. Retrieved from: <https://www.pub.gov.sg/abcwaters/about>. See also Singapore's National Water Agency (PUB) Press Release. (2013, April 23). PUB's Active, Beautiful, Clean Waters (ABC Waters) Programme wins at Global Water Awards 2013, *Singapore's National Water Agency (PUB)*. Retrieved from: https://www.nas.gov.sg/archivesonline/data/pdfdoc/20130430003/pub_press_release_23_apr_2013.pdf

⁴⁵⁶ Singapore's National Water Agency (PUB) Press Release. (2013, April 23). PUB's Active, Beautiful, Clean Waters (ABC Waters) Programme wins at Global Water Awards 2013, *Singapore's National Water Agency (PUB)*. Retrieved from: https://www.nas.gov.sg/archivesonline/data/pdfdoc/20130430003/pub_press_release_23_apr_2013.pdf

programme adopted in 2003 which consists on the usage of recycled water from used water for daily use.⁴⁵⁷

In 2001, PUB also introduced in its agenda sanitation policies, as suggested by the Ministry of Environment and Water Resources. This helped Singapore to progressively reach international credit on water policies. Indeed, Singapore annually hosts the Singapore International Water Week.⁴⁵⁸

Furthermore, two local academic institutions are ranked as the world's two leading universities in the water research field, namely the National University of Singapore and the Nanyang Technological University.⁴⁵⁹

Thus, Singapore is now a global laboratory in the water sector, attracting foreign investment and exporting its resources towards at least 200 cities in the developing world which need clean water and better sanitation services. To this respect, the public sector has worked in partnership with the private one in order to support innovations in the water field. For example, Hyflux is a private Singaporean company which opened, supported by the government, two desalination plants in 2013, with operations worldwide.⁴⁶⁰

4.3 Problems and opportunities in the process towards sustainability

Singapore's strong commitment towards climate change is first of all due to its vulnerability as an island-state. Secondly, it is committed to transform its urban design into a Garden City, or rather a city in a garden, because climate change problem is encouraging cities to implement drastic measures towards a sustainable future. The case of Singapore is one of a kind since it needed to deploy such measures to survive climate related consequences. Indeed, the fundamental reason why Singapore has developed in this way is represented by its precarious condition due to its small extension and its position that makes it vulnerable, as it is located in a transshipment area in front of the Strait of Malacca. It therefore poses the risk of being attacked by possible pirates or by both regional and global financial and economic crisis. For this reason, Singapore had to

⁴⁵⁷ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 127

⁴⁵⁸ Ibid

⁴⁵⁹ Ivi, p. 128. See also Lux Research. (2013, April 30). Singapore Universities Top Ranking of Water Research Institutes, *Lux Research*. Retrieved from: <https://www.luxresearchinc.com/press-releases/singapore-universities-top-ranking-of-water-research-institutes>

⁴⁶⁰ Ibid

develop in a smart and green way to try to survive global shocks, especially climate change. This is its strength.

As already underlined in the previous paragraphs, Singapore's geographical location and its size constitute the major challenges for the city's green growth, because it lacks of natural resources and thus it is difficult to implement alternative uses. Hence, Singapore is taking advantage of its only resources available at the moment, namely natural gas and solar power, while also developing innovative measures in the water and food supply sectors. Innovative technology in the industrial, building, transportation, household, water and waste sectors is the key towards sustainability and green management in the years ahead, in particular focusing on lowering carbon emissions by 2030, together with green transformations everywhere in the city.

Water scarcity represents a fundamental concern for Singapore, up to the point of converting its absence into a major resource management issue that allows the city to be recognised globally. The land-use challenge is another problem to be analysed with further attention, since land is the scarcer commodity in Singapore. At the same time, urban parks and green management have enabled the city to become a leader in biodiversity enhancement and quality of living increase.

4.3.1 Water scarcity and water quality

As said before, water scarcity is a major concern for Singaporeans. PUB's campaign explains it very well: "Make every drop count.". This campaign aims at building responsibility and awareness on the importance of water conservation, warning the population that behind every drop of water there is a complex treatment process. The Singaporean government committed to invest in water resources and infrastructure able to treat raw water in order to meet water needs.⁴⁶¹

The Water Resources Institute (WRI) ranked Singapore as one of the most vulnerable countries for what concerns water supply. The simple reason is due to the fact that Singapore lacks of spaces available to collect and store the water needed. Nevertheless, the ability to ensure water security and sustainability guarantees Singapore's survival and

⁴⁶¹ Singapore's National Water Agency (PUB) Press Release. (2019, February 24). Make Every Drop Count. PUB to launch campaign to build more pervasive water-saving culture and make water conservation a way of life, *Singapore's National Water Agency (PUB)*. Retrieved from: <https://www.pub.gov.sg/news/pressreleases/MakeEveryDropCount2019>

economic growth. Thus, PUB enhanced a water strategy in order to guarantee water quality for all.⁴⁶²

First of all, since Singapore was hardly hit by drought periods some 50 years ago, in addition to heavy rainfalls, PUB embarked on ambitious projects. Rainwater storage and treatment was the primary strategy adopted. Then, used water collected from sinks and sewers was transformed into NEWater, ultra-clean water. About ten years ago, PUB began to build desalination plants for seawater treatment, being this last process the most direct since Singapore is surrounded by water. These three strategic moves led the city-state to turn one of its greatest vulnerabilities into a strength. NEWater and desalinated water represent nowadays two resilient resources for Singapore, which is confronting with an increasingly changing climate. Along with these processes, energy efficiency is required, since NEWater and desalination require increasing energy usage.⁴⁶³

According to “Our Water, Our Future”, water recycling and desalination processes will supply at least 85% of Singapore’s future water needs.⁴⁶⁴

NEWater, integrated in the “four-tap strategy”, is amongst the most important measures taken so far in Singapore. NEWater is recognised under the United States EPA and the World Health Organisation (WHO) drinking water guidelines. Following PUB’s researches, by 2060 NEWater alone will reach up to 55% of Singapore’s water needs.⁴⁶⁵ Actually, Singapore’s sustainable water policies follow three key strategies: collection of every drop of water, water recycling, desalination of seawater.⁴⁶⁶

Singapore’s public and private sectors are jointly working for developing new sustainable technologies for water solutions, such as new industrial water solutions. By 2060, the industrial sector will account for 70% of Singapore’s water demand, while the household sector will account only for the remaining 30%. Indeed, industrial water sector management has become a priority for Singapore, also considering its water-intensive industries, especially in sectors like petrochemicals, electronics and pharmaceuticals.⁴⁶⁷

⁴⁶² Singapore’s National Water Agency (PUB). (2018). *Our Water, Our Future*, Singapore: Singapore’s National Water Agency (PUB), p. 2

⁴⁶³ Ivi, pp. 4-6

⁴⁶⁴ Ivi, p. 7

⁴⁶⁵ Ivi, p. 9

⁴⁶⁶ Ivi, p. 11

⁴⁶⁷ Ivi, p. 16

Nowadays, water is not only a resource, but it is also an economic asset, since millions of public funds have been invested in environment technologies. More than 180 companies and 20 water research centres come from Singapore. These companies and centres are recognised worldwide, up to the point of denominating Singapore the “Global Hydrohub”.⁴⁶⁸

In the next 15 years, PUB will expand its water infrastructure. The major project is the Deep Tunnel Sewerage System (DTSS), to be completed by 2025. In this case, all used water from households will flow into this underground tunnel until reaching one coastal reclamation plant for water treatment. Not only would this system be efficient, but it would also occupy 50% less land than what is normally used by used water infrastructure. Together with this new underground system, which comprehends different connected pipelines, new desalination and NEWater plants will be built by 2025 and will supply up to 85% of Singapore’s water demand by 2060.⁴⁶⁹

In the long-run, green spaces and clean water will represent the transformative key to make Singapore a liveable and sustainable city.

PUB works in synergy with the community in order to improve water consumption habits; for example, by 2030 households will cut their water use per capita per day to 140 litres. Firstly, PUB priced water to prevent people from consuming it. The price reflects the value of water production and supply, but it also includes a Water Conservation Tax to underline the precious water value. Since 2009, PUB introduced the Mandatory Water Efficiency Labelling Scheme (WELS); under this scheme, suppliers must list the water efficiency of their water machines and appliances on packaging and publicity, so that consumers can do better choices. Moreover, PUB is carrying out studies, together with the NUS, to better analyse water consumption habits in households. For example, they designed a smart shower device embedded in the showerhead capable of showing real-time information about the amount of water used. The same happens for the non-domestic sector, where industries must submit their water consumption levels annually to the PUB under the Water Efficiency Management Plans (WEMP). In order to incentivise domestic and non-domestic sectors to consume less water, the PUB awards a biennial prize to the top water efficiency performers under the Water Efficiency Index (WEI). A number of awareness campaigns are offered to the youngest. PUB works closely with the Ministry

⁴⁶⁸ Ivi, p. 17

⁴⁶⁹ Ivi, pp. 18-26

of Education (MOE) in order to expand some general good rules for water saving at school. Under the “Time-to-Save” programme introduced in 2013, some characters encourage children to save water, explaining them the real water value: PUB’s water hero, Water Wally, Professor Save and Water Waster are some of the characters included in this programme that comprehends a “shower dance” performance to promote in a fun way the message of doing 5-minutes showers.⁴⁷⁰

Singapore has become a country focused on great water management, innovative ideas and holistic solutions. These last will become increasingly important and a strength for the city-state, with cooperative work in the first place.

4.3.2 “Sand war”

From the 1960s onwards, Singapore’s territory expanded by about 20%, thanks to a drainage system that allowed the country to recover land from the sea, including through the use of additional sands. For Singapore, the need to expand the territorial area stems from population growth and the consequent need to find new areas available for the construction of housing, but also to expand the infrastructure and transport system. In recent years, Singapore has entered into a dispute with neighbouring countries, especially Indonesia and Malaysia, over allegations of illegal sand trafficking from the beaches of the two countries to Singapore itself. Malaysia, together with Indonesia, Cambodia and Vietnam, has in fact imposed a ban on the export of sand, since this practice is considered harmful to the conservation of its natural heritage. It is estimated that thousands of tons of sand are taken by traffickers who, with small boats, reach the nearby Malaysian and Indonesian coasts, smuggling them to Singapore. This activity has contributed to a tenuous relationship between the latter and its neighbouring countries.⁴⁷¹ Singapore’s reliance on sand imports is also due to the fact that industrial sand is the world’s most extracted material; indeed, it is essential for the production of cement, concrete and asphalt. Global demand for sand is ever increasing also due to the fast urbanisation process our cities are facing. It is not a coincidence that 70% of the world’s industrial sand is used in Asia. Of

⁴⁷⁰ Ivi, pp. 33-45

⁴⁷¹ Treccani. (2012) La “Guerra della sabbia” di Singapore, In *Atlante Geopolitico*, *Treccani*.

Retrieved from: https://www.treccani.it/enciclopedia/la-guerra-della-sabbia-di-singapore_%28Atlante-Geopolitico%29/

course, extracting sand endangers natural habitats.⁴⁷² Environmentalists affirmed that more than 500 million tons of sand has been exported from the Cambodian province Koh Kong to Singapore during the past years, endangering the Cambodian mangrove ecosystem and fishing communities.⁴⁷³ Anyway, Singapore is decreasing more and more its reliance on sand imports.⁴⁷⁴

According to the journalist Samanth Subramanian of the New York Times, the land challenge is the most cherished ambition for Singapore. Following governmental forecasts, land reclamation will make Singapore grow in size from 224 square miles to about 300 square miles by 2030.⁴⁷⁵ Of course, reclaiming land from the ocean is not advantageous in terms of environmental protection. Scientific forecasts warn that by 2100 sea level rise and dangerous storms will reach a drastic point.⁴⁷⁶ As a small island, contrary to other diminutive islands such as Kiribati or the Maldives, Singapore has a lot to share for what concerns land reclamation. Many coastal cities, such as New York, Miami, Rio de Janeiro, Mumbai, etc. watch its example with attention. The Marina Bay Financial Centre has been constructed above reclaimed land, as well as a number of parks, decks and coastal roads. The majority of Changi Airport lies above reclaimed land as well. The Jurong Rock Caverns, the major underground facility that stores liquid hydrocarbons in Southeast Asia, also represent an answer to the doubts about Singapore's capacity to create so much land for itself, saving nearly 60 hectares of land above ground.⁴⁷⁷

⁴⁷² The Economist. (2017, July 19). Why is sand in short supply? *The Economist*. Retrieved from: <https://www.youtube.com/watch?v=8J78ezpadFo&t=144s>

⁴⁷³ Murdoch, L. (2016, February 26). Sand wars: Singapore's growth comes at the environmental expense of its neighbours, *The Sydney Morning Herald*. Retrieved from: <https://www.smh.com.au/world/sand-wars-singapores-growth-comes-at-the-environmental-expense-of-its-neighbours-20160225-gn3uum.html>

⁴⁷⁴ Subramanian, S. (2017, April 20). How Singapore Is Creating More Land for Itself. The island off the southern tip of Malaysia reveals the future of building in an epoch of dwindling territory, In *Climate Issue*, *The New York Times*. Retrieved from: <https://www.nytimes.com/2017/04/20/magazine/how-singapore-is-creating-more-land-for-itself.html>

⁴⁷⁵ Ibid

⁴⁷⁶ Ibid

⁴⁷⁷ Ibid. See also Jurong Town Corporation (JTC). (2021, December 2). Jurong Rock Caverns, *Jurong Town Corporation (JTC)*. Retrieved from: <https://www.jtc.gov.sg/find-space/jurong-rock-caverns>

A consequence of landlessness is the massive population density increase in a relatively small area, also due to economic growth and wealth in Singapore. However, this has provoked a land-price augmentation across the city. Land use is managed by the URA, the national planning authority of the city-state, which, together with the HDB, manages the urban infrastructure.⁴⁷⁸

The urban planning process in Singapore is managed by two plans, the Concept Plan and the Master Plan, which are revised by the URA every 10 years and every 5 years, respectively. These plans aim at ensuring a liveable and efficient environment through land use policies, in particular to guarantee that there is sufficient land to meet population density and economic growth.⁴⁷⁹

4.3.3 Biodiversity and quality of living: urban parks and green management

As explained in the previous chapters, nowadays Singapore is one of the greenest cities in the world. This result is due to the great efforts done by the government in partnership with its agencies, ministries and boards, which worked in synergy in order to provide shade and greenery for the population, but also to ameliorate the quality of living through the plantation of flowering trees and shrubs, to give joy and happiness and to improve the general mood for all.

NParks has adopted biophilic designs⁴⁸⁰ for habitats' restoration throughout the city's green spaces, while also spurring the community in sustaining their greening efforts together.⁴⁸¹ As of April 2020, NParks has safeguarded about 7800 hectares of green spaces, comprehending reserves, parks and gardens, linked by the PCN across Singapore.⁴⁸²

Singapore is a city where the population is deeply connected to the natural world around it, which comprehends a vast variety of greenery, but also a number of flora and fauna species. Above all, this is a city built with the work of all the community, sustaining the

⁴⁷⁸ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 112

⁴⁷⁹ Ivi, pp. 113-116

⁴⁸⁰ Biophilic design aims at linking urban areas with the natural environment through the design and use of natural spaces

⁴⁸¹ Singapore National Parks Website. (2021, October 8). Singapore, a City in Nature, *Singapore National Parks Website*. Retrieved from: <https://www.nparks.gov.sg/about-us/city-in-nature>

⁴⁸² Ibid

effort of conserving its natural heritage so that all can enjoy nature's benefits, and also the generations to come.⁴⁸³

The five key strategies in order to build Singapore City in Nature are: to extend Singapore's natural capital, to increase the natural element in parks and gardens, to restore nature into the urban landscape, to strengthen the network between Singapore's green spaces, and to enhance veterinary care.⁴⁸⁴

NParks strives to increase the PCN with the aim of reaching 200 hectares more by 2030, so that local natural reserves can be protected by the impact of urbanisation, and people can enjoy Singapore's biodiversity more and more.⁴⁸⁵ The island-city hosts many types of vegetation, from grasslands, scrublands and woodlands to forests. The tropical rainforest is the main vegetation type native to Singapore; forests consist of various layers of vegetation, such as the understorey, sub-canopy, canopy, and finally the really tall emergent layer. Biodiversity conservation starts from a scientific-based and holistic approach. Different strategies are adopted for different areas, depending on the type of vegetation and its importance in strengthening ecological connectivity. All of this contribute to the primary goal of enriching biodiversity across the island and achieving the City in Nature vision. This is done by safeguarding the core biodiversity areas in Singapore through its nature reserves, home to many native plants and animals. Furthermore, recovery efforts of rare or endangered species are also underway. Through surveys and monitoring, NParks learn more about Singapore's forests, and this helps it to make better informed decisions.⁴⁸⁶

By 2026, NParks aims at building 300 hectares more of gardens and parks, comprehending therapeutic gardens and nature playgardens for the youngest (30 therapeutic gardens will be built by 2030), with water and native species incorporated into them. By 2030, NParks will recover 100 species of plants and 60 species of animals

⁴⁸³ Singapore National Parks Website. Singapore, A City in Nature, *Singapore National Parks Website*. Retrieved from: <https://www.youtube.com/watch?v=uta4HenSRzQ&t=178s>

⁴⁸⁴ Singapore National Parks Website. (2021, October 8). Singapore, a City in Nature, op. cit.

⁴⁸⁵ Ibid

⁴⁸⁶ Singapore National Parks Website. NParks Explains: Different Shades of Green, *Singapore National Parks Website*. Retrieved from: https://www.youtube.com/watch?v=X3LV5F_RcLM&t=281s

through species recovery plans, and also it will restore 30 hectares of forest, marine and coastal habitats.⁴⁸⁷

Another step towards greenness is the creation of Nature Ways, a planting scheme which aims at intensifying the greening along Singapore's streets to make walks more comfortable for pedestrians, and to enhance resilience to the effects of crowding and urbanisation. NParks is striving to achieve 300 km of Nature Ways by 2030, with the long-term goal of transforming every road into a Nature Way. In addition to this, NParks is planning to enhance skyrise greenery to 200 hectares by 2030, and it will plant more than 170,000 trees in industrial sites to cool that areas and improve the air quality.⁴⁸⁸

According to NParks, trees are an essential part of our ecosystem: they provide animals with food, shelter and nesting materials, they also provide shade and help to cool down our surroundings, they regulate air and water quality, as well as the climate through carbon sequestration.⁴⁸⁹

5.3 Singapore's commitment to Agenda 2030

Agenda 2030 was adopted in September 2015 at the United Nations Sustainable Development Summit in New York. At the core of this agenda, there are 17 SDGs, namely no poverty, zero hunger, good health and well-being, quality education, gender equality, clean water and sanitation, affordable and clean energy, decent work and economic growth, industry innovation and infrastructure, reduced inequalities, sustainable cities and communities, responsible consumption and production, climate action, life below water, life on land, peace, justice and strong institutions, and finally partnerships for the goals.⁴⁹⁰

⁴⁸⁷ Singapore National Parks Website. (2021, October 8). Singapore, a City in Nature, op. cit.

⁴⁸⁸ Ibid

⁴⁸⁹ Singapore National Parks Website. Benefits Of Our Trees | OneMillionTrees Movement, *Singapore National Parks Website*. Retrieved from: <https://www.youtube.com/watch?v=WcnoDmQS2eE&t=114s>

⁴⁹⁰ United Nations Department of Economic and Social Affairs (UNDESA). The 17 Goals | Sustainable Development, *United Nations Department of Economic and Social Affairs (UNDESA)*. Retrieved from: <https://sdgs.un.org/goals>. See also United Nations Department of Global Communications (UNDGC). Do you know all 17 SDGs? *United Nations Department of Global Communications (UNDGC)*. Retrieved from: <https://www.youtube.com/watch?v=0XTBYMfZyrM&t=84s>

The Division for Sustainable Development Goals (DSDG) of the UN Department of Economic and Social Affairs (UNDESA) plays an important role in the evaluation of UN performances and implementation of the Agenda 2030 and in supporting SDGs and its related activities.⁴⁹¹

This Agenda, “Transforming our world: the 2030 Agenda for Sustainable Development”, is the new plan for action of the post-2015 development agenda. It endorses actions necessary for achieving sustainable development, in particular focusing on the “5 Ps”: people, planet, prosperity, peace and partnership.⁴⁹² A key goal for reaching sustainable development is Goal 17 - partnership for the goals. A Global Partnership for Sustainable Development has been created in order to support collaborative actions to fight climate change, starting from climate finance.⁴⁹³ Cooperation also means the necessity of helping developing countries to survive to and to be resilient to global warming effects. Thus, the new Agenda must be implemented by both the public and the private sectors, in particular referring to multinational corporations, the main emitters of GHG, as already depicted in detail in chapter one.⁴⁹⁴

As it is explained in the previous chapters, Singapore actively participates in international summits and actions, being an interested member of the UN. It strived, and it is actually striving further and further, for reaching sustainable development in all its forms, from the environmental to the economic to the social ones. To this end, Singapore’s undertaking in Agenda 2030 SDGs is fundamental, and it is accompanied by local commitments, such as Singapore’s Climate Action Plan and SGP2030. First of all, Singapore green city aims at becoming a City in Nature. Thus, it pays particular attention to Goal 11 - to make cities and human settlements inclusive, safe, resilient and sustainable. Sustainable urbanism is related to efficient transport management, energy efficiency, pollution prevention, security. As specified in paragraph 11.2 of Goal 11 of the Agenda, by 2030 the UN will commit to “provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding

⁴⁹¹ Ibid

⁴⁹² United Nations General Assembly (UNGA). (2015, September 25). Transforming our world: the 2030 Agenda for Sustainable Development, op. cit., pp. 1-2

⁴⁹³ Ivi, p. 10

⁴⁹⁴ Ibid

public transport, with special attention to the needs of those in vulnerable situations...”.⁴⁹⁵ Moreover, Singapore also accounts for Goal 13 - to take urgent action to combat climate change and its impacts. Indeed, the small island-state is strongly engaged in fighting against climate change impacts that are affecting the local environment and safety of the population, from sea-level rise to frequent and heavy rainstorms.⁴⁹⁶ In addition to this, since Singapore lacks of natural resources, and water is a fundamental resource for the human condition, it also commits to strengthen Goal 6 and 14 - respectively to ensure availability and sustainable management of water and sanitation for all, and to conserve and sustainably use the oceans, seas and marine resources for sustainable development. It is known that water management is a fundamental concern for the city-state, which is implementing holistic and innovative measures in order to obtain safe and secure water both for households and industries.⁴⁹⁷

These are the main goals Singapore is committed to as a green city-state, but it also accounts for the others as it is part of the global community with respect for the “5 Ps”.

⁴⁹⁵ Ivi, pp. 21-22

⁴⁹⁶ Ivi, p. 23

⁴⁹⁷ Ivi, pp. 18-23

CONCLUSION

The present work has proposed a deep analysis through a specific case study in order to assess how the organisation and development of a “green city” can represent a solution, amongst others, to the problem of climate change. Indeed, as already asserted in the second chapter, cities are the place where the majority of the population lives, where infrastructure, technologies, industries and firms develop. Cities have always been the centre of innovation and development thanks to different activities which take place there, from cultural to industrial ones. Indeed, the C40 Cities Climate Leadership Group stated that cities represent the key to address climate change problems.⁴⁹⁸ This arises from the acknowledgment that local actions can really make the difference, since they can have immediate impacts at local level and they can contribute to global effects.⁴⁹⁹ In this sense, as mentioned throughout the work, a multi-level and multi-actor approach is needed in order to face international problems. This is what “governance” means. The starting point for understanding the importance that governance is acquiring in today’s debate on global and environmental problems is the acknowledgment that we live in a complex and uncertain world. Nowadays, we need a good governance based on the concept of openness, participation, accountability, coherence, peace. This means that the national government is fundamental, but also business and citizens’ involvement and participation are required in order to address the global problem we have to cope with. Cities are part of this process.⁵⁰⁰

The need to develop a thesis of this kind, linked to such a contemporary and important issue as like fragile and dangerous, is born from the will and the need to express a personal opinion and to find at least an answer to the current crisis that affects all of us without geographical, economic and social differences. I have found a solution in sustainable urbanism, although there are still many steps to overcome and many limits, in some cases. To this end, it results fundamental to transform the cities into green spaces in order to confront serious problems related to climate change. Indeed, the discourse about green cities implies seeking win-win solutions, balancing environment with economy, with a

⁴⁹⁸ C40 Cities. (2012). *Why cities? Ending climate change begins in the city*, op. cit.

⁴⁹⁹ Ibid

⁵⁰⁰ Blewitt, J. (2018). *Understanding Sustainable Development*, op. cit., pp. 151-153

focus on social inclusion and participation, while also talking about social narratives and urban marketing.

Thus, this thesis has focused on a specific case study, namely Singapore city-state. I choose this city because it represents an example to follow internationally in terms of greenery, not only because it is regarded as Asia's greenest city, but also because it could transform its limits into a strength. As I have already depicted in the second chapter, Singapore could achieve this reputation thanks to its technocratic leadership, in particular, from Lee Kuan Yew to Goh Chok Tong to Lee Hsien Loong. According to Khanna, the role of technocracy in Asia is subverting the Western democratic vision, since global political discourse is shifting from democracy towards a technocratic governmental field, in which the performance of a country is the new parameter for determining its success, under meritocratic and utilitarian rules.⁵⁰¹ From this view, we must not infer that democracy is undesirable, since it is both a fundamental basis of political legitimacy and a pillar of every successful technocracy. In broad terms, democracy must not be intended as the only universal solution, but as a principle to observe in order to reach the final goal, the good governance. The elements of any good governance are measured through some specific indicators, such as the legislative process, the autonomous bureaucracy, and the efficient services, for example. Successful governance also means to rapidly adapt to global challenges, developing successful strategies with capacity building and decision-making.⁵⁰²

The third chapter proposes a deep analysis of Singapore's characteristics which distinguish it from other cities. In this sense, Singapore is both green and smart. Green because the national government spurs for a great collaboration between public and private sector in order to create an efficient Garden City, and this achievement has been possible thanks to the efficient government and community's commitment and engagement in keeping Singapore a best-in-class city. PM Lee Hsien Loong's first goal is indeed nature conservation and sustainability. One of Singapore's major achievements in 2014 was the winning of the title of UNESCO World Heritage city-state for its Botanic Gardens, for example.⁵⁰³ Smart in the sense that it is both minimalist and enabling, two

⁵⁰¹ Khanna, P. (2019). *Il Secolo Asiatico?* Op. cit.

⁵⁰² Khanna, P. (2017). *La rinascita delle città-stato. Come governare il mondo al tempo della devolution*, op. cit., pp. 37-38

⁵⁰³ Han, H. (2017, March). Singapore, a Garden City, op. cit., pp. 3-24

fundamental characteristics of the SS. Minimalist because it assumes a low-profile, providing the right conditions for efficiency and transparency in the international arena, focusing on integration and social inclusion. Enabling since it provides people with all the necessary tools in order to be self-reliant, thanks to the support of the government together with the business. Three key aspects differentiate Singapore from other nation-states, namely social protection, economic development and national security, in a minimalist and enabling perspective.

Furthermore, Singapore has an emblematic role in the international scenario, being part of the UN and taking part at important global conferences, such as COP meetings. Hence, it is strongly committed towards Agenda 2030, as it is explained in the last chapter. That considered, the city-state is undertaking Agenda 2030 SDGs because it shares the urgent need for collaborative action both nationally and internationally.

Given that the indirect goal of this thesis is to create a link between people and nature, Singapore has proved to be the perfect candidate for this work. After many researches and studies, I could select this city because it has a strong commitment towards its community and the world. Its leadership is highly accountable to the population, because it includes everyone in every activity and it pushes to respect the city and the community, starting from simple environmental rules. Agenda 2030 SDGs commitment, for example, is undertaken by every sector of the society, from business to institutions, also including children from their first years of elementary school. I also choose this city because it has a holistic approach both in government and governance, thanks to its perseverant leader. In addition, it is an example both at regional and international level, and this foreign interest is dictated by Singapore's precarious circumstances and its consequent stimulus to act in an innovative and holistic way to problems.⁵⁰⁴ For instance, Singapore has faced positively the era of the Digital Revolution and the IoT, thanks to its innovative urban structural network and its adaptive capacity.

The main purpose of this dissertation has been that of answering a specific question, namely whether green cities represent a way to contrast global problems, in this case climate change. Nowadays, there are a number of green cities, and the major world capitals are approaching to eco-friendly measures. We are in the right direction, even if there are still many steps to take. In this respect, UN Agenda 2030 SDGs have the

⁵⁰⁴ Calder, K. E. (2016). *Singapore: Smart City Smart State*, op. cit., p. 12

objective of ending poverty and hunger, achieving inclusive education for all, gender equality, employment and decent work for all, reduce inequalities, and others. As specified in Goal 11, to make cities and human settlements inclusive, safe, resilient and sustainable is a major objective.⁵⁰⁵ Singapore, indeed, feels strongly this commitment, up to the point of being called “a City in a Garden”. It is noteworthy to remind that amongst the first initiatives to transform Singapore into a Garden City, Lee Kuan Yew launched different campaigns aimed at increasing greenery and shade throughout the city, such as “The Tree Planting” campaign or the “Garden City” campaign.

The concluding remarks of this thesis arise from the fact that cities have always been the centre of innovation, so that they have the potential to improve and change the world. Sometimes, local actions can determine better results than international-level actions. Indeed, a great work between cities included in the C40 Cities Climate Leadership group (including Singapore) is currently making a difference in the improvement of climate action, starting from cities and urban planning. In fact, cities represent our present and our future, according to UNDESA forecasts that the majority of the world population will live in urban spaces (by 2050, over 68% of the world population will live in cities)⁵⁰⁶. Hence, it is of utmost importance that climate mitigation and adaptation solutions start there. As I have demonstrated in this dissertation, a possible solution to the question I have raised can be Singapore model. Indeed, already during PM Lee Kuan Yew’s first mandate, and even before independence, tree planting and gardening campaigns were the primary goal at that moment. The following State leaders continued through this path, bringing the city to become a leader in sustainability. It is clear that the vulnerable situation in which Singapore grew pushed the city to focus on innovative measures in line with the context, but these circumstances clearly helped the city to become a leader in terms of environmental, economic and social sustainability, also determining its success. SGP2012, SGP2030 and the Climate Action Plan 2016 represent an example of Singapore’s commitment, together with the level of satisfaction of its citizens towards the government’s accountability. Singapore is therefore a model for other countries and cities

⁵⁰⁵ United Nations General Assembly (UNGA). (2015, September 25). Transforming our world: the 2030 Agenda for Sustainable Development, op. cit., pp. 21-22

⁵⁰⁶ United Nations Department of Economic and Social Affairs (UNDESA). (2018). World Urbanisation Prospects: The 2018 Revision, op. cit., p.1

(in particular for its neighbouring China), which emulate it especially in the business and environmental fields. Moreover, Singapore is considered the most famous technocracy of Asia, and this is another reason why others watch it as an example at the international level. Hence, it is possible to conclude that Singapore green and smart city-state represents both a model for other countries and a feasible solution to climate change threats, based on the research I have concluded and on the vast literature regarding this topic.

LIST OF REFERENCES

- Primary sources

Aarhus Convention. (1998, June 25). Retrieved from: <https://ec.europa.eu/environment/aarhus/>

Additional Protocol to the American Convention of Human Rights in the area of Economic, Social and Cultural rights “Protocol of San Salvador”. (1988, November 17). Art. 11: The Right to a Healthy Environment. Retrieved from: https://www.ohchr.org/_layouts/15/WopiFrame.aspx?sourcedoc=/Documents/Issues/Environment/Mappingreport/13.Inter-American-26March.doc&action=default&DefaultItemOpen=1

African Charter. (1986, October 21). Art. 24: Right to a General Satisfactory Environment. Retrieved from: <https://www.achpr.org/legalinstruments/detail?id=49>

Council of the European Union. (2008, March 3). Climate change and international security, Report 7249/08, Brussels. Retrieved from: <https://data.consilium.europa.eu/doc/document/ST%207249%202008%20INIT/EN/pdf>

European Convention on Human Rights (ECHR), Art. 2/Art. 8, Section I. Retrieved from: https://www.echr.coe.int/documents/convention_eng.pdf

Eurobarometer. (2021, from March to April). Climate change. Retrieved from: <https://europa.eu/eurobarometer/surveys/detail/2273>

Gates, B. (2014). Annual Letter 2014, *Bill & Melinda Gates foundation*. Retrieved from: <https://www.gatesfoundation.org/ideas/annual-letters>

Global Covenant of Mayors. Retrieved from: <https://www.globalcovenantofmayors.org>

Inter-American Court of Human Rights. (2017, November 15). Advisory Opinion OC-23/17. Retrieved from: <https://elaw.org/system/files/attachments/publicresource/English%20version%20of%20AdvOp%20OC-23.pdf>

Localizing Agenda 21 (LA21). Retrieved from: <https://mirror.unhabitat.org/content.asp?typeid=19&catid=540&cid=5023>

London Datastore. Retrieved from: <https://data.london.gov.uk>

Paris Agreement. (2015, December 12). Art. 6. Retrieved from: https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english.pdf

San Francisco Ecocity Declaration. (2008, May 15). *Ecocity Media (blog)*. Retrieved from: <https://ecocity.wordpress.com/2008/05/15/san-francisco-ecocity-declaration/>

Sustainable Cities Programme (SCP). Retrieved from: https://www.fukuoka.unhabitat.org/programmes/detail04_03_en.html

The World Bank. (2020, April 20). Urban Development, *The World Bank*. Retrieved from: <https://www.worldbank.org/en/topic/urbandevelopment/overview>

United Nations Framework Convention on Climate Change (UNFCCC). (1992). Art. 4.10: Commitments, *United Nations (UN)*. Retrieved from: https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf

United Nations General Assembly (UNGA). (1948, December 10). Universal Declaration of Human Rights (UDHR), Resolution 217/A, Paris. Retrieved from: <https://www.un.org/en/about-us/universal-declaration-of-human-rights>

United Nations General Assembly (UNGA). (2015, September 25). Transforming our world: the 2030 Agenda for Sustainable Development, *Resolution adopted by the General Assembly on 25 September 2015, A/70/L.1*, New York: UNGA. Retrieved from: https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

World Summit for Social Development (WSSD). (1995, March 6-12). Copenhagen Declaration on Social Development (CDOSD), Part A, Art. 13, Copenhagen. Retrieved from: <https://www.un.org/development/desa/dspd/world-summit-for-social-development-1995/wssd-1995-agreements/cdosd-part-a.html>

- **Secondary sources**

Books

Alexandra Health. (2020, September 30). *A Healing Space. Creating Biodiversity at Khoo Tech Puat Hospital*, Yishun Health: Singapore

Asian Development Bank (ADB). (2012, November). *Green Cities*, Mandaluyong City, Philippines: Asian Development Bank

Asian Development Bank (ADB). (2013). *The Social Protection Index Database: Assessing Results for Asia and the Pacific*, Manila, Philippines: Asian Development Bank

Asian Development Bank (ADB). (2015). *Key Indicators for Asia and The Pacific 2015*, Mandaluyong City, Philippines: Asian Development Bank, 46th Ed

Baldin, S. & De Vido, S. (2020). *Environmental Sustainability in the European Union: Socio-Legal Perspectives*, Trieste: Edizioni Università di Trieste (EUT)

Barber, B. (2013). *If Mayors Ruled The World: Dysfunctional Nations, Rising Cities*, Yale University Press

Barnett, J., Matthew, R. A. & O'Brien, K. (2010). *Global Environmental Change and Human Security*, Cambridge, MA: MIT Press

Blewitt, J. (2018). *Understanding Sustainable Development*, London and New York: Routledge, III Ed.

Braman, J., James, M. & Kats, G. (2010). *Greening Our Built World: Costs, Benefits, and Strategies*, Washington: Island Press

Calder, K. E. (2016). *Singapore: Smart City Smart State*, Washington, D.C.: Brookings Institution Press

Department of Statistics Singapore. (2021). *Population Trends 2021*, Singapore: Department of Statistics, Ministry of Trade & Industry

Economist Intelligence Unit. (2011). *Asian Green City Index*, Munich, Germany: Siemens AG

Escobar, A. (2011). *Encountering Development: The Making and Unmaking of the Third World*, Princeton: Princeton University Press

Fook, L. L., Hofmeister, W. & Rueppel, P. (2014). *Eco-Cities: Sharing European and Asian Best Practices and Experiences*, EU-Asia Dialogue. Shaping a Common Feature for Europe and Asia – Sharing Policy Innovation and Best Practices in Addressing Common Challenges, Singapore: National Library Board

Giddens, A. (2011). *The Politics of Climate Change*, Cambridge: Polity Press, II Ed.

International Energy Agency (IEA). (2019). *CO₂ Emissions from Fuel Combustion*, OECDiLibrary

Jäger, J. et al. (2004). *Global Change and the Earth System: A Planet Under Pressure*, I Ed., Heidelberg, Germany: Springer

Johnson, H. D. (2008). *Green Plans: blueprint for a sustainable earth*, University of Nebraska Press

Khanna, P. (2016). *Connectography: mapping the future of global civilization*, New York: Random House

Khanna, P. (2017). *La rinascita delle città-stato. Come governare il mondo al tempo della devolution*, Roma: Fazi Editore srl, I Ed., traduzione di Thomas Fazi

Khanna, P. (2019). *Il secolo Asiatico?* Roma: Fazi Editore srl, I Ed., traduzione di Thomas Fazi

Matan, A., Newman, P. (2013). *Green Urbanism in Asia: The Emerging Green Tigers*, Singapore: World Scientific Publishing

McGill, K. (2016). *Global Inequality*, Toronto: University of Toronto Press

Micklethwait, J. & Wooldridge, A. (2015). *The Fourth Revolution: The Global Race to Reinvent the State*, Penguin Books Ltd

Ministry of the Environment and Water Resources & Ministry of National Development. (2016). *Singapore's Climate Action Plan: A Climate-Resilient Singapore, For a Sustainable Future*, Singapore: Ministry of the Environment and Water Resources & Ministry of National Development

Organization for Economic Co-operation and Development (OECD). (2006). *Infrastructure to 2030: Telecom, Land Transport, Water and Energy*, Paris: OECD Publishing

Ostojic, D. R., Bose, R. K., Krambeck, H., Lim, J. & Zhang, Y. (2013). *Energizing Green Cities in Southeast Asia: Applying Sustainable Urban Energy and Emissions Planning*. Washington, DC: World Bank

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*, New York: Cambridge University Press

Rosecrance, R. (1999). *The Rise of the Virtual State: Wealth and Power in the Coming Century*, New York: Basic Books

Singapore's National Water Agency (PUB). (2018). *Our Water, Our Future*, Singapore: Singapore's National Water Agency (PUB)

Singer, M. (2018). *Climate Change and Social Inequality: The Health and Social Costs of Global Warming*. Routledge, 1 Ed.

Strategy Group Prime Minister's Office, National Climate Change Secretariat. (2016). *Singapore's Climate Action Plan. Take Action Today, for a Carbon-Efficient Singapore*, Singapore: Strategy Group Prime Minister's Office, National Climate Change Secretariat

Strategy Group Prime Minister's Office, National Climate Change Secretariat. (2020). *Charting Singapore's Low Carbon and Climate Resilient Future*, Singapore: Strategy Group Prime Minister's Office, National Climate Change Secretariat

The International Bank for Reconstruction and Development/The World Bank. (2010). *Energy efficient cities. Assessment Tools and Benchmarking Practices*, Washington D. C.: The World Bank

United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). (2012). *Low Carbon Green Growth Roadmap for Asia and the Pacific. Turning resource constraints and the climate crisis into economic growth opportunities*, Bangkok: UNESCAP

United Nations Environment Programme (UNEP). *Towards a green economy: pathways to sustainable development and poverty eradication*, UNEP, corp. ed.

United Nations Environment Programme (UNEP). (2012). *Sustainable, Resource Efficient Cities – Making It Happen!* UNEP

United Nations Environment Programme (UNEP). (2016). *The ABC for sustainable cities. A glossary for policy makers*, UNEP

Vogel, E. F. (2011). *Deng Xiaoping and the Transformation of China*, Cambridge: The Belknap Press of Harvard University Press

Wright, C. & Nyberg, D. (2015). *Climate Change, Capitalism, and Corporations. Processes of Creative Self-Destruction*, Cambridge University Press

Papers, articles, reports, websites

Abo El-Enien O. M., Elrayies, G. M., Mahmoud, M. F. & Yakoub, W. A. (2019, March 16-20). *Ambassadors of Sustainability: An Analytical Study of Global Eco-Friendly Cities*, Menoufia University, Faculty of Engineering

Alusi, A., Eccles, R. G., Edmondson, A. C. & Zuzul, T. (2011, March 20). *Sustainable Cities: Oxymoron or the Shape of the Future?* Harvard Business School

Anwar, S. & Sam, C.-Y. (2012, March). *Is Economic Nationalism good for the Environment? A case study of Singapore*, In Asian Studies Review, Routledge

Barrett, K. L., Long, M., A., Lynch, M. J. & Stretesky, P. B. (2017). *Social Justice, environmental destruction, and the Trump presidency: A criminological perspective*, *Social Justice: A Journal of Crime, Conflict, and World Order*, 44:1

Berdahl, P. & Bretz, S. (1997). *Preliminary Survey of the Solar Reflectance of Cool Roofing Materials*, In Energy and Buildings, Elsevier, 5:2

Berloco, M. (2014/2015). *Smart Cities: Green Economy, Innovazione e Sostenibilità nelle città del futuro*, Tesi di laurea in Economia e Gestione dei Servizi di Pubblica Utilità, *Luiss Guido Carli*

Bertoli, C. (2021, December 21). Il ruolo di Singapore alla COP26, 11, *Opinio Juris*. Retrieved from: <https://www.opiniojuris.it/il-ruolo-di-singapore-alla-cop-26/>

Bowler, D. E., Buyung-Ali, L., Knight, T. M. & Pullin, A. S. (2010). Urban greening to cool towns and cities: A systematic review of the empirical evidence, In *Landscape and Urban Planning, Elsevier*, 97:3

Breil, M., Ellena, M. & Soriani, S. (2020, July 22). The heat-health nexus in the urban context: A systematic literature review exploring the socio-economic vulnerabilities and built environment characteristics, In *Urban Climate, Elsevier*, 34

Brzoska, M. & Fröhlich, C. (2015, March 30). Climate change, migration and violent conflict: vulnerabilities, pathways and adaptation strategies, In *Migration and Development, Routledge*, 5:2

Building and Construction Authority (BCA). (2017, May). NTU, a living lab for sustainability, gets greener, In *Pillars, Building and Construction Authority (BCA)*. Retrieved from: <https://www.bca.gov.sg/emailsender/microsite/Pillars-052017/future-ready1.html9>

Building and Construction Authority (BCA). (2021, February). “80-80-80 in 2030” Infographic, *Building and Construction Authority (BCA)*. Retrieved from: https://www1.bca.gov.sg/docs/default-source/docs-corp-buildsg/sustainability/sgbmp-80-80-80-in-2030-infographic.pdf?sfvrsn=57172d48_2

Building and Construction Authority (BCA). (2021, February). Engagement Report Infographic, *Building and Construction Authority (BCA)*. Retrieved from: https://www1.bca.gov.sg/docs/default-source/docs-corp-buildsg/sustainability/report-infographics.pdf?sfvrsn=c891f6d2_0

Building and Construction Authority (BCA). (2021, February). Singapore Green Building Masterplan. Public Engagement Report, *Building and Construction Authority (BCA)*

Building and Construction Authority (BCA). (2021, February). Sustainable Construction, *Building and Construction Authority (BCA)*. Retrieved from: <https://www1.bca.gov.sg/buildsg/sustainability/sustainable-construction>

Building and Construction Authority (BCA). Green Building Masterplans, *Building and Construction Authority (BCA)*. Retrieved from: <https://www1.bca.gov.sg/buildsg/sustainability/green-building-masterplans>

Building and Construction Authority (BCA). Green Mark Certification Scheme, *Building and Construction Authority (BCA)*. Retrieved from: <https://www1.bca.gov.sg/buildsg/sustainability/green-mark-certification-scheme>

Building and Construction Authority (BCA). Mass Engineered Timber, *Building and Construction Authority (BCA)*. Retrieved from: <https://www1.bca.gov.sg/buildsg/productivity/design-for-manufacturing-and-assembly-dfma/mass-engineered-timber>

Busby, J. (2007). Climate change and National Security: An Agenda for Action, *Council on Foreign Relations*, Council Special Reports (CSR) no. 32. Retrieved from: https://cdn.cfr.org/sites/default/files/report_pdf/ClimateChange_CSR32%20%281%29.pdf

C40 Cities. Retrieved from: <https://www.c40.org>

C40 Cities. Our Cities. Retrieved from: <https://www.c40.org/cities/>

C40 Cities. (2012). Why cities? Ending climate change begins in the city, *C40.org*. Retrieved from: <https://www.c40.org/ending-climate-change-begins-in-the-city>

Camarda, C. & Macca, G. (2021, December 2). Sustainability is not a label! It's about mindset and process, In Public Communication(s) in Europe, Bruxelles: Belgian State – Chancellery of the Prime Minister, Club of Venice 35 years

Campbell, S. (1996). Green Cities, Growing Cities, Just Cities? Urban Planning and the Contradictions of Sustainable Development, *Journal of the American Planning Association*, 62:3

Caprotti, F. (2013, August 12). Critical research on eco-cities? A walk through the Sino-Singapore Tianjin Eco-City, China, In *Cities*, *Elsevier*

Caprotti, F. (2014). Eco-urbanism and the Eco-city, or, Denying the Right to the City? *Antipode*, 46:5

Caprotti, F. (2017). Emerging low-carbon urban mega-projects. In Dhakal, S., Ruth, M. (eds), *Creating Low Carbon Cities*, Berlin: Springer

Carley, S., Lawrence, S. (2011). Energy-based Economic Development, In *Renewable and Sustainable Energy Reviews*, *Elsevier*, 15:1

Castán Broto, V., Bulkeley, H. (2013). A survey of urban climate change experiments in 100 cities. In *Global Environmental Change*, *Elsevier*, 23:1

Central Intelligence Agency (CIA). (2021, November 9). The World Factbook: Singapore, *Central Intelligence Agency (CIA)*. Retrieved from: <https://www.cia.gov/the-world-factbook/countries/singapore/#energy>

Central Provident Fund Board (CPF Board). MediSave, *Central Provident Fund Board (CPF Board)*. Retrieved from: <https://www.cpf.gov.sg/members/schemes/schemes/healthcare/medisave>

Centre for Climate Crime Analysis (CCCA). Prosecuting climate crimes as a matter of priority and general deterrence, *CCCA*. Retrieved from: <http://www.climatecrimeanalysis.org/priority-prosecution.html>

Centre for Climate Research Singapore (CCRS). (2015). Singapore's Second National Climate Change Study, *Centre for Climate Change Research Singapore (CCRS)*. Retrieved from: <http://ccrs.weather.gov.sg/publications-second-national-climate-change-study-science-reports/>

Centre for International Law (CIL) National University of Singapore. (2019, August 20). An introduction to ASEAN, *Centre for International Law (CIL) National University of Singapore*. Retrieved from: <https://cil.nus.edu.sg/research/asean-law-policy/topics/asean-resources/an-introduction-to-asean/>

Chabert, V. (2021, November 14). La COP26 volge al termine: un bilancio del vertice internazionale sul clima di Glasgow, *Opinio Juris*. Retrieved from: <https://www.opiniojuris.it/la-cop26-volge-al-termino-un-bilancio-del-vertice-internazionale-sul-clima-di-glasgow/>

Chew, V. (2010). Public Housing in Singapore, *Singapore Infopedia*. Retrieved from: https://eresources.nlb.gov.sg/infopedia/articles/SIP_1585_2009-10-26.html

Chew, V. (2016, August 17). Singapore Green Plan, *Singapore Infopedia*. Retrieved from: https://eresources.nlb.gov.sg/infopedia/articles/SIP_1370_2008-11-22.html.

Climate Nexus. Common but differentiated responsibilities and respective capabilities (CBDR-RC), *Climate Nexus*. Retrieved from: <https://climatenexus.org/climate-change-news/common-but-differentiated-responsibilities-and-respective-capabilities-cbdr-rc/#mobile-site-navigation>

Cocchia, A., Dameri, R. P. (2013, December 14). Smart and Digital city: twenty years of terminology evolution, *ItAIS 2013, X Conference of the Italian Chapter of AIS*, Milan. Retrieved from: <http://www.itais.org/proceedings/itais2013/pdf/119.pdf>

Corriere Asia. (2021). Storia di Singapore. *Corriere Asia*. Retrieved from: <https://www.corriereasia.com/storia-di-singapore/>

Cowley, R., Joss, S. & Tomozeiu, D. (2011, September). Eco-cities – A Global Survey 2011, International Eco-cities Initiative, *University of Westminster*

Curien, R. (2017). Singapore, a Model for (Sustainable?) Urban Development in China. An Overview of 20 years of Sino-Singaporean Cooperation, *China Perspectives*, 1

De Châtel, F. (2014, January 27). The Role of Drought and Climate Change in the Syrian Uprisings: Untangling the Triggers of the Revolution, In *Middle Eastern Studies, Routledge*, 50:4

De Ferrer, M. (2020, October 11). How has Singapore learned to blend nature with urban living? In *Green News, Euronews.green*. Retrieved from: <https://www.euronews.com/green/2020/11/10/how-has-singapore-learned-to-blend-nature-with-urban-living>

Department of Statistics – Singapore. Retrieved from: <https://www.singstat.gov.sg/whats-new/latest-data>

Earth.org. (2021, May 17). The World's 10 Greenest Cities in 2021, *Earth.org*. Retrieved from: <https://earth.org/the-worlds-greenest-cities-in-2021/>

Economic Development Board (EDB) Singapore. About EDB, *Economic Development Board (EDB) Singapore*. Retrieved from: <https://www.edb.gov.sg/en/about-edb/who-we-are.html>

Eden Strategy Institute & OXD (ONG&ONG Experience Design). (2018/2019). Retrieved from: <https://www.smartcitiesworld.net/news/news/report-ranks-top-50-smart-cities-on-leadership-and-governance-3100>

European Commission. What are smart cities? In Smart Cities. Cities using technological solutions to improve the management and efficiency of the urban environment, *European Commission*. Retrieved from: https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en#what-are-smart-cities

Europol. Environmental Crime, In Crime Areas, *Europol*. Retrieved from: <https://www.europol.europa.eu/crime-areas-and-trends/crime-areas/environmental-crime>

Europol. (2018, May 4). Europol and the centre for climate crime analysis together against criminal activities related to air pollution and deforestation, *Press Release*. Retrieved from: <https://www.europol.europa.eu/newsroom/news/europol-and-centre-for-climate-crime-analysis-together-against-criminal-activities-related-to-air-pollution-and-deforestation>

Fair, C. (2020, April 22). The World's Greenest Cities are our future, In Best Cities, *Resonance*. Retrieved from: <https://www.bestcities.org/news/2020/04/22/the-worlds-greenest-cities/>

Freedom House. (2021). Freedom in the World Rankings 2021 – Singapore, Freedom House. Retrieved from: <https://freedomhouse.org/country/singapore/freedom-world/2021>

Global Climate Action NAZCA. Retrieved from: <http://climateaction.unfccc.int>

Global-is-Asian. Singaporean Lee Kuan Yew School of Public Policy. Retrieved from: <https://lkyspp.nus.edu.sg/gia>

Gonella, F. (2019, December 20). The Smart Narrative of a Smart City, In Urban Resource Management, *Frontiers in Sustainable Cities*, 1:9

Green City Network. (2020). Charter for the green city urban regeneration. To get out of the crisis, after the pandemic, with more care for our future, *Fondazione Sviluppo Sostenibile*. Retrieved from: <https://www.fondazionevilupposostenibile.org/wpcontent/uploads/CHARTER-FOR-THE-GREEN-CITY-URBAN-REGENERATION.pdf>

Hamilton-Hart, N. (2006). Singapore's Climate Change Policy: The limits of learning, *Contemporary Southeast Asia*, 28:3

Hammer, S., Kamal-Chaoui, L., Plouin, M. & Robert, A. (2011). Cities and Green Growth: A conceptual Framework, *OECD Regional Development Working Papers*

Han, H. (2017, March). Singapore, a Garden City, In *The Journal of Environment & Development*, Sage Publications, Inc, 26:1

Harvey, N., Pow, C. P. (2015). Eco-cities and the Promise of Socio-Environmental Justice, *The International Handbook of Political Ecology*, Edited by Raymond L. Bryant

Hassan, R. (1969). Population change and urbanisation in Singapore, In *Civilisations, Institut de Sociologie de l'Université de Bruxelles*, 19:2

Hernandez, E. (2017, June 5). America's biggest greenhouse-gas polluter, and the place that relies on it, *Centre for Public Integrity*. Retrieved from: <https://publicintegrity.org/environment/americas-biggest-greenhouse-gas-polluter-and-the-place-that-relies-on-it/>

Ho, A. (2009, October 30). Reasons for Singapore to be cool on global warming, *The Straits Times*. Retrieved from: <https://eresources.nlb.gov.sg/newspapers/>

Ho, J. (2006, July-August). The security of sea lanes in Southeast Asia, 46:4, *Asian Survey*

Ho, S. (2013, November 5). Mass Rapid Transit (MRT) System, *Singapore Infopedia*. Retrieved from: https://eresources.nlb.gov.sg/infopedia/articles/SIP_2013-11-05_131443.html

Hopkins, J. (2016, September 29) Meet America's super polluters, *USA Today*. Retrieved from: <https://eu.usatoday.com/story/news/2016/09/29/toxic-air-pollution-concentrated-small-number-sites/90846584/>

Housing and Development Board (HDB). (2021, February 14). Sample Household Survey 2018: The HDB Living Experience, *Housing and Development Board (HDB)*. Retrieved from: https://www.hdb.gov.sg/cs/infoweb/about-us/news-and-publications/press-releases/14022021_Sample_Household_Survey_2018

Housing and Development Board (HDB). (2021, March 4). Ensuring Public Housing Remains Affordable, Inclusive, and Liveable. Speech by Mr Desmond Lee. *Housing and Development Board (HDB)*. Retrieved from: <https://www.hdb.gov.sg/cs/infoweb/about-us/news-and-publications/press-releases/04032021-Ensuring-public-housing-remains-affordable-inclusive-and-liveable>

Hui Hong, C. & Al-Rikabi, R. (2014, February 25). Singapore Bids for Role as LNG Hub with Second Terminal, *Bloomberg News*. Retrieved from: <https://www.bloomberg.com/news/articles/2014-02-25/singapore-plans-to-build-second-lng-terminal-in-country-s-east>

Huntjens, P., Lebel, L., Pahl-Wostl, C., Camkin, J., Schulze, R. & Kranz, N. (2012). Institutional design propositions for the governance of adaptation to climate change in the water sector, In *Global Environmental Change, Elsevier*, 22:1

Huntjens, P. & Nachbar, K. (2015). Climate Change as a Threat Multiplier for Human Disaster and Conflict, *The Hague Institute Working Paper Series*, Working paper 9

IESE Business School's Centre for Globalization and Strategy. (2019). Retrieved from: <https://www.smartcity.press/top-10-smart-cities-of-2019/>

International Monetary Fund (IMF). (2008, October). World Economic Outlook Database, *International Monetary Fund (IMF)*. Retrieved from: <https://www.imf.org/en/Publications/>

International Panel on Climate Change (IPCC). (1990). First assessment report, Working group II, Geneva. Retrieved from: https://www.ipcc.ch/site/assets/uploads/2018/03/ipcc_far_wg_II_full_report.pdf

International Peace Research Association (IPRA) Commission on Ecological Security. (1995, March). *Newsletter*, 95:1

Jurong Town Corporation (JTC). (2021, December 2). Jurong Rock Caverns, *Jurong Town Corporation (JTC)*. Retrieved from: <https://www.jtc.gov.sg/find-space/jurong-rock-caverns>

Land Transport Authority (LTA). Retrieved from: <https://www.lta.gov.sg/content/ltagov/en.html>

Lankao, R., Huq, S., Pelling, M., Reid, H. & Satterthwaite, D. (2007, October 1). Adapting to Climate Change in Urban Areas. The possibilities and constraints in low- and middle-income nations, *IIED Working Paper*

Lee Kuan Yew World City Prize. Biography: Peter Ho, *Lee Kuan Yew World City Prize*. Retrieved from: <https://www.leekuaneyewworldcityprize.gov.sg/about/prize-jury/prize-council/peter-ho/>

Leiserowitz, A., Maibach, E., Roser-Renouf, C. & Smith, N. (2010), Global Warming's Six Americas, *Yale Project on Climate Change*, New Haven: Yale University and George Mason University. Retrieved from: <https://climatecommunication.yale.edu/wpcontent/uploads/2016/02/2010-June-Six-Americas.pdf>

Lux Research. (2013, April 30). Singapore Universities Top Ranking of Water Research Institutes, *Lux Research*. Retrieved from: <https://www.luxresearchinc.com/press-releases/singapore-universities-top-ranking-of-water-research-institutes>

McDonald, M. (2018, July). Climate change and security: Towards ecological security? In *International Theory*, *Elsevier*, 10:2

Media Relations Division, Ministry of Information, Communications and the Arts. Discourse by the Minister of the Environment Lee Swee Say at the launch of the Singapore Green Plan 2012, 10.00 am, August 24, 2002, Sheraton Towers. Retrieved from: <https://www.nas.gov.sg/archivesonline/data/pdfdoc/2002082405.html>

Milosovicova, J. (2008, July 7). Douglas Farr: Sustainable Urbanism. *Urban Design with Nature*, *TU Berlin*

Ministry of Education Singapore. (2021, October 18). Edusave Account: Overview, *Ministry of Education Singapore*. Retrieved from: <https://www.moe.gov.sg/financial-matters/edusave-account/overview>

Ministry of Health Singapore. (2018, March 7). Speech by Mr Gan Kim Yong, Minister for Health, at the Ministry of Health Committee of supply debate 2018, *Ministry of Health Singapore*. Retrieved from: <https://www.moh.gov.sg/news-highlights/details/speech-by-mr-gan-kim-yong-minister-for-health-at-the-ministry-of-health-committee-of-supply-debate-2018>

Moynihan, C. (2020, September 20). A New York Clock That Told Time Now Tells the Time Remaining, *The New York Times*. Retrieved from: <https://www.nytimes.com/2020/09/20/arts/design/climate-clock-metronome-nyc.html>

Murray, S. (2019). The critical role of infrastructure for the Sustainable Development Goals, *The Economist Intelligence Unit*

Murdoch, L. (2016, February 26). Sand wars: Singapore's growth comes at the environmental expense of its neighbours, *The Sydney Morning Herald*. Retrieved from: <https://www.smh.com.au/world/sand-wars-singapores-growth-comes-at-the-environmental-expense-of-its-neighbours-20160225-gn3uum.html>

Nadotti, C. (2021, February, 19). Sempre più calde e meno umide: le città del futuro saranno bollenti, *La Repubblica*. Retrieved from: https://www.repubblica.it/green-and-blue/2021/02/19/news/sempre_piu_calde_e_meno_umide_le_citta_del_futuro_saranno_bollenti-288019262/

Nanyang Technological University Singapore (NTU Singapore) website. Colleges & Schools. Retrieved from: <https://www.ntu.edu.sg/education/colleges-schools>

Nanyang Technological University Singapore (NTU Singapore) website. EcoCampus. Retrieved from: https://www.ntu.edu.sg/erian/research-focus/flagship-programmes/ecocampus#Content_C012_Col00

NASA Global Climate Change. (2021, April 15). Overview: Weather, Global Warming and Climate Change, *NASA Global Climate Change*. Retrieved from: <https://climate.nasa.gov/resources/global-warming-vs-climate-change/>

NASA Global Climate Change. (2021, July 27). The Effects of Climate Change, *NASA Global Climate Change*. Retrieved from: <https://climate.nasa.gov/effects/>

NASA Goddard Institute for Space Studies. Global Annual Mean Surface Air Temperature Change, Credit: NASA/JPL-Caltech. Retrieved from: https://data.giss.nasa.gov/gistemp/graphs_v4/

National Geographic. From Mega-Regions to Micro-Size Homes: Cities of The Future, In The Cities Issue, *National Geographic*. Retrieved from: <https://www.nationalgeographic.com/magazine/graphics/see-sustainable-future-city-designed-for-people-and-nature>

National Geographic. Urban Heat Island, *Resource Library: Encyclopedic Entry*. Retrieved from: <https://www.nationalgeographic.org/encyclopedia/urban-heat-island/>

National Heritage Board Singapore. The Lion Head Symbol. Retrieved from: <https://www.nhb.gov.sg/what-we-do/our-work/community-engagement/education/resources/national-symbols/the-lion-head-symbol>

National Parks Board. Community in Bloom initiatives, *National Parks Board*. Retrieved from: <https://www.nparks.gov.sg/gardening/community-in-bloom-initiative>

National Parks Board. National Biodiversity Centre, *National Parks Board*. Retrieved from: <https://www.nparks.gov.sg/biodiversity/national-biodiversity-centre>

National Parks Board. Recreational Connectivity. Explore nature throughout Singapore – walk or cycle on enhanced routes. *National Parks Board*. Retrieved from: <https://www.nparks.gov.sg/gardens-parks-and-nature/park-connector-network>

National Parks Board & Greenroofs.com. (2020, February 19). Khoo Tech Puat Hospital (KTPH), *Greenroofs.com*. Retrieved from: <https://www.greenroofs.com/projects/khoo-teck-puat-hospital-ktph/>

Ness, D. (2007, May 27). Smart, sufficient and sustainable infrastructure systems, background paper for a UN Expert Group Meeting (EGM) on Sustainable Infrastructure Development (SID) held in Bangkok, 11-13 June, 2007

Oxfam International. (2015, December 2). World's richest 10% produce half of carbon emissions while poorest 3.5 billion account for just a tenth, *Oxfam International*. Retrieved from: <https://www.oxfam.org/en/press-releases/worlds-richest-10-produce-half-carbon-emissions-while-poorest-35-billion-account>

Ostrom, E. (2007, September 25). A Diagnostic Approach for Going Beyond Panaceas, *Proceedings of the National Academy of Sciences, PNAS*, 104:39

Oswald, J. (2016, August 3). China Turns to Ecology in Search of 'Civilisation', *Asian Studies Association of Australia*. Retrieved from: <https://asaa.asn.au/china-turns-to-ecology-in-search-of-civilisation/>

Our World in Data. (2021). Share of electricity production from renewables, 2020, *BP Statistical Review of World Energy & Ember (2021)*. Retrieved from: <https://ourworldindata.org/grapher/share-electricity-renewables?country=~ETH>

People's Association (PA). Community Clubs, *People's Association*. Retrieved from: <https://www.pa.gov.sg/our-network/community-clubs>

People's Association (PA). Grassroots Organisations, *People's Association*. Retrieved from: <https://www.pa.gov.sg/our-network/grassroots-organisations>

Prime Minister's Office Singapore. (2012, September 29). Speech by Prime Minister Lee Hsien Loong at the Singapore Manufacturers' Federation 80th Anniversary Dinner. Retrieved from: <https://www.pmo.gov.sg/Newsroom/speech-prime-minister-lee-hsien-loong-singapore-manufacturers-federation-80th>

Prime Minister's Office Singapore. (2013, October 26). Speech by Prime Minister Lee Hsien Loong at the Launch of Clean and Green Singapore 2014, *Prime Minister's Office Singapore*. Retrieved from: <https://www.pmo.gov.sg/Newsroom/speech-prime-minister-lee-hsien-loong-launch-clean-and-green-singapore-2014>

QS World University Rankings 2022. Retrieved from: <https://www.topuniversities.com/university-rankings/world-university-rankings/2022>

Resonance Consultancy Website. Retrieved from: <https://resonanceco.com>

Saiu, V. (2017, December 15). The Three Pitfalls of Sustainable City: A Conceptual Framework for Evaluating the Theory-Practice Gap, in Sustainability, *MDPI*, 2311:9

Sarkar, A. N. (2016). Eco-innovations in Designing Eco-cities and Eco-towns, *The Smart City Journal*. Retrieved from: <https://www.thsmartcityjournal.com/en/articles/1042-eco-innovations-eco-cities-eco-towns>

Satterthwaite, D. (2007). The Transition to a Predominantly Urban World and its Underpinnings, *IIED Working Paper*

Singapore Government Directory. Statutory Boards, *Singapore Government Directory*. Retrieved from: <https://www.sgdi.gov.sg/statutory-boards>

Singapore Government Website. Singapore Green Plan 2030. Retrieved from: <https://www.greenplan.gov.sg/key-focus-areas/overview>

Singapore National Parks Website. 1963: The Greening of Singapore, In Singapore Botanic Gardens, *Singapore National Parks*. Retrieved from: <https://www.nparks.gov.sg/sbg/about/our-history/1963-the-greening-of-singapore>

Singapore National Parks Website. (2021, October 8). Singapore, a City in Nature, *Singapore National Parks Website*. Retrieved from: <https://www.nparks.gov.sg/about-us/city-in-nature>

Singapore's National Water Agency (PUB) Press Release. (2013, April 23). PUB's Active, Beautiful, Clean Waters (ABC Waters) Programme wins at Global Water Awards 2013, *Singapore's National Water Agency (PUB)*. Retrieved from:

https://www.nas.gov.sg/archivesonline/data/pdfdoc/20130430003/pub_press_release_23_apr_2013.pdf

Singapore's National Water Agency (PUB) Press Release. (2019, February 24). Make Every Drop Count. PUB to launch campaign to build more pervasive water-saving culture and make water conservation a way of life, *Singapore's National Water Agency (PUB)*. Retrieved from: <https://www.pub.gov.sg/news/pressreleases/MakeEveryDropCount2019>

Singapore's National Water Agency (PUB). (2020, November 23). Active, Beautiful, Clean Waters Programme, *Singapore's National Water Agency (PUB)*. Retrieved from: <https://www.pub.gov.sg/abcwaters/about>

Skilling, D. (2013). Strategic coherence and ruthlessness are allowing many smaller countries – from Singapore to Israel – to succeed in turbulent times, In In Praise of Small States, *Global Brief*. Retrieved from: <https://globalbrief.ca/2013/06/in-praise-of-the-small-states/>

Strategy Group Prime Minister's Office Singapore, National Population and Talent Division. Retrieved from: <https://www.population.gov.sg/our-population/population-trends/overview>

Strategy Group Prime Minister's Office Singapore. (2012, July 26). Our Population Our Future: Issues Paper July 2012. Retrieved from: <https://www.strategygroup.gov.sg/media-centre/publications/our-population-our-future>

Street, F. (2021, June 22). World's most expensive cities for expats in 2021 revealed, *CNN travel*. Retrieved from: <https://edition.cnn.com/travel/article/worlds-most-expensive-cities-expats-2021/index.html>

Subramanian, S. (2017, April 20). How Singapore Is Creating More Land for Itself. The island off the southern tip of Malaysia reveals the future of building in an epoch of dwindling territory, In Climate Issue, *The New York Times*. Retrieved from: <https://www.nytimes.com/2017/04/20/magazine/how-singapore-is-creating-more-land-for-itself.html>

Tan, J. (2013, March 26). S'pore Still a Target for Terrorism: PM Lee, *Yahoo Newsroom*. Retrieved from: <https://sg.news.yahoo.com/s'pore-still-a-target-for-terrorism--pm-lee-065553326.html>

The Economist. (2020, November 18). Where are the world's most expensive cities? *The Economist*. Source: The Economist intelligence Unit. Retrieved from: <https://www.economist.com/graphic-detail/2020/11/18/where-are-the-worlds-most-expensive-cities>

Tan-Mullins, M. (2018). Who are green cities actually for? In GREEN CITY: Explorations and Visions of Urban Sustainability, *RCC Perspectives*, 1

The Political and Economic Risk Consultancy. (2018). Annual Review of Corruption in Asia 2018, *Asian Intelligence*. Retrieved from: <http://www.asiarisk.com/subscribe/dataindx.html>

The World Bank. (2019). World Development Indicators | DataBank, *The World Bank*. Retrieved from: <https://databank.worldbank.org/source/world-development-indicators>

The World Bank. (2020). World Development Indicators | DataBank, *The World Bank*. Retrieved from: <https://databank.worldbank.org/source/world-development-indicators>

Transparency International. (2020). Corruption Perceptions Index 2020, *Transparency International*. Retrieved from: <https://www.transparency.org/en/cpi/2020/index/sgp>

Treccani. (2012) La “Guerra della sabbia” di Singapore, In Atlante Geopolitico, *Treccani*. Retrieved from: https://www.treccani.it/enciclopedia/la-guerra-della-sabbia-di-singapore_%28Atlante-Geopolitico%29/

United Nations (UN). Member States. Retrieved from: <https://www.un.org/en/about-us/member-states#gotoS>

United Nations Climate Change (UNCC) Website. Conference of the Parties. In Bodies, *United Nations Climate Change*. Retrieved from: <https://unfccc.int/process/bodies/supreme-bodies/conference-of-the-parties-cop>

United Nations Climate Change Conference UK 2021. Gli obiettivi della COP26, *United Nations Climate Change Conference UK 2021*. Retrieved from: <https://ukcop26.org/it/gli-obiettivi-della-cop26/>

United Nations Department of Economic and Social Affairs (UNDESA). The 17 Goals | Sustainable Development, *United Nations Department of Economic and Social Affairs (UNDESA)*. Retrieved from: <https://sdgs.un.org/goals>

United Nations Department of Economic and Social Affairs (UNDESA). (2014). World Urbanization Prospects: The 2014 Revision, *UNDESA*. Retrieved from: <https://population.un.org/wup/Publications/Files/WUP2014-Report.pdf>

United Nations Department of Economic and Social Affairs (UNDESA). (2018). World Urbanization Prospects: The 2018 Revision, *UNDESA*. Retrieved from: <https://population.un.org/wup/Publications/Files/WUP2018-Report.pdf>

United Nations Development Program (UNDP). (1994). Human Development Report 1994, New York: Oxford University Press. Retrieved from: http://www.hdr.undp.org/sites/default/files/reports/255/hdr_1994_en_complete_nostats.pdf

United Nations Human Settlements Programme (UN-Habitat). (2014). Planning for Climate Change. Retrieved from: <https://unhabitat.org/sites/default/files/download-manager-files/Planning%20for%20Climate%20Change.pdf>

United Nations World Water Assessment Programme (UNWWAP). (2017). Wastewater: The Untapped Resource, *The United Nations World Water Development Report 2017*, Paris: UNESCO. Retrieved from: <http://www.unesco.org/new/en/naturalsciences/environment/water/wwap/wwdr/2017-wastewater-the-untapped-resource/>

Urban Redevelopment Authority (URA). (2008, May 21). URA launches new Island-wide Leisure Plan. About the Draft Master Plan 2008, *Urban Redevelopment Authority*. Retrieved from: <https://www.ura.gov.sg/Corporate/Media-Room/Media-Releases/pr08-54>

US Environmental Protection Agency (EPA). (2004, August). Constructed Treatment Wetlands, *US Environmental Protection Agency (EPA)*. Retrieved from: <https://nepis.epa.gov/Exe/ZyPDF.cgi/30005UPS.PDF?Dockkey=30005UPS.PDF>

US Environmental Protection Agency (EPA). (2008). Reducing Urban Heat Islands: Compendium of Strategies, *US Environmental Protection Agency (EPA)*. Retrieved from: https://www.epa.gov/sites/production/files/201705/documents/reducing_urban_heat_islands_ch_1.pdf

US Environmental Protection Agency (EPA). (2019, February 4). The Sources and Solutions: Fossil Fuels, In Nutrient Pollution, *US Environmental Protection Agency (EPA)*.

Retrieved from: <https://www.epa.gov/nutrientpollution/sources-and-solutions-fossil-fuels>

US Environmental Protection Agency (EPA). (2020, November 2). Reduce Urban Heat Island Effect, *US Environmental Protection Agency (EPA)*. Retrieved from: <https://www.epa.gov/green-infrastructure/reduce-urban-heat-island-effect>

Vasagar, J. (2021, November 12). Singapore: Freddi Tropici, *Internazionale*, 1435

Videos

Greenroofs.com. (2014, March 24). Khoo Tech Puat Hospital – Project of the Week 2/24/14. Retrieved from: <https://www.youtube.com/watch?v=oU3pDxP1rUo&t=105s>

Khanna, P. (2016). How megacities are changing the map of the world, *TEDx2016*.

Retrieved from:

https://www.ted.com/talks/parag_khanna_how_megacities_are_changing_the_map_of_the_world/details?referrer=playlist-our_future_in_cities#t-315129

Khanna, P. (2016, October 5). What is connectography? *Temasek Digital*. Retrieved from: <https://www.youtube.com/watch?v=k-Ftn9ESoxM>

Nanyang Technological University Singapore (NTU Singapore) website. NTU President Prof Subra Suresh's message on Sustainability. Retrieved from: https://www.youtube.com/watch?v=hCzMJ_fJPUA&t=273s

Prime Minister's Office Singapore. (2013, October 26). Speech by Prime Minister Lee Hsien Loong at the Launch of Clean and Green Singapore 2014, *Prime Minister's Office Singapore*. Retrieved from: <https://www.pmo.gov.sg/Newsroom/speech-prime-minister-lee-hsien-loong-launch-clean-and-green-singapore-2014> Video of the speech: <https://www.youtube.com/watch?v=TNSQ44NeveA&t=26s>

Steer, A. (2014, December 8). Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). Retrieved from: <https://vimeo.com/114001116> (this video by IISD Reporting Services provides an overview of the GPC, which is a tool that enables cities to report all of their GHG emissions through one single method. Produced by Nicole de Paula and filmed/edited by Elizabeth Press)

Singapore Government Website. Singapore Green Plan 2030. Retrieved from: <https://www.greenplan.gov.sg/key-focus-areas/overview>. Video of the SGP30: <https://www.youtube.com/watch?v=oNFeOI7pW9s>

Singapore National Parks Website. Singapore, A City in Nature, *Singapore National Parks Website*. Retrieved from: <https://www.youtube.com/watch?v=uta4HenSRzQ&t=178s>

Singapore National Parks Website. NParks Explains: Different Shades of Green, *Singapore National Parks Website*. Retrieved from: https://www.youtube.com/watch?v=X3LV5F_RcLM&t=281s

Singapore National Parks Website. Benefits Of Our Trees | OneMillionTrees Movement, *Singapore National Parks Website*. Retrieved from: <https://www.youtube.com/watch?v=WcnoDmQS2eE&t=114s>

The Economist. (2017, July 19). Why is sand in short supply? *The Economist*. Retrieved from: <https://www.youtube.com/watch?v=8J78ezpadFo&t=144s>

United Nations Climate Change (UNCC): e-Learn. Cities and Climate Change, online course. Retrieved from: <https://unccelearn.org/course/view.php?id=21&page=course>

United Nations Department of Global Communications (UNDGC). Do you know all 17 SDGs? *United Nations Department of Global Communications (UNDGC)*. Retrieved from: <https://www.youtube.com/watch?v=0XTBYMfZyrM&t=84s>