REVIEW OF WORLD PLANNING PRACTICE

VOLUME 16: POST-OIL URBANISM

ISOCARP


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Review of World Planning Practice
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ISOCARP President's Foreword

Martin Dubbeling
ISOCARP PRESIDENT 2018-2021

We live in exciting and troublesome times that require us to be resourceful, creative and agile. Due to the COVID-19 pandemic and the climate crisis, the health and the well-being of ourselves and our communities are at stake. Our ideas, perceptions and priorities in designing and building cities better are shifting. At our first ever, fully-virtual, World Planning Congress *Post-Oil City*: *Planning for Urban Green Deals*, we have the opportunity to exchange ideas and visions, encourage each other and build coalitions amongst city and regional planners, place makers, academia, practitioners and consultants.

Urban green deals are essential for cities. Nationwide energy infrastructures based on sustainable energy will change the way we use, build, plan and design our landscapes and cities. Wind parks, solar fields and electric and thermal storage facilities will have an impact on land use in and around cities. Regional planners, landscape architects and urban designers play a crucial role in leading the way towards revisioning and recreating our landscapes and cities. More than ever before, we now realize that making cities healthier places for living and working should be on the top of the agenda of every government, mayor, city planner and developer.

Some 50 years ago, Prof. Sam van Embden, the founding father and first President of ISOCARP, already emphasized his opinion that city and regional planners are the doctors and surgeons of cities. These urban medics know how our patients should change their lifestyles and, if necessary, they know where and how to operate to improve their well-being. We, as urban and regional planners, should stand up and take full responsibility in making and designing better and more healthier cities and public places.

Between 8 and 13 February 2020 ISOCARP actively participated in the Tenth Session of the World Urban Forum (WUF10) in Abu Dhabi, which hosted 13,000 participants. At WUF10, we initiated and participated in networking events, roundtables and special sessions. We had a very successful booth at the Exhibition hall that we shared with NTNU. In this way we renewed and made new contacts with cities, universities, planning institutes and agencies resulting in new members and new opportunities for ISOCARP activities. We discussed combined efforts to make cities and regions more healthy, resilient, livable and meaningful by connecting culture and innovation. We signed up to the Abu Dhabi Declaration of the Global Planners Network, to which we now have become a signatory member. Together with Planning Aid Scotland, we launched and established Global Planning Aid to train grassroots community planners.

Since the start of the pandemic many things have had to changed. ISOCARP and the ISOCARP Institute, like many organizations, had to take quarantine precautions, adapt operations at the Secretariat, cancel international travelling and in-person meetings, and enhance virtual communications with our members and followers. This has taken up much of our time and attention. At present all in-person UPAT and YPP workshops are on hold, and as international traveling is and will be disrupted for quite some time, we now are focusing on providing on-line interactions. I want to express my sincere appreciation to our staff who worked from home and continued and even intensified their

support to the Society and the Institute. Our new reality also kickstarted new initiatives. We are building a new open-source paper platform using the experience and generous help of Manfred Schrenk and Clemens Beyer of REAL CORP. We have initiated thematic *Communities of Practices on Urban Health and Urban Innovation* using the leadership of our energetic Secretary General Frank D'hondt and stewarded by Jens Aerts, Elisabeth Belpaire and Marco Kamiya, Michael Stott, Ana Peric, and Annie Woo. Board Member Ali Alraouf initiated a first regional Community of Practice with focus on the MENA region.

On a personal note, as a planning practitioner working on Rebuilding the City of Delfzijl (see page 172-187 of this Review), I very much experienced that this new reality requires unorthodox and innovative ways of cooperation and communication (see photo). Covid 19 restrictions have changed how we perform workshops, in-person communication and presentations in public events and town hall meetings. Face-to-face transactions are now done remotely using our home and office computers. At ISOCARP we face the same challenges. We are an active network that thrives on personal contacts, mentoring, teaching, workshops and co-production. Professor Juanee Cilliers our first *Cyber Agora* Curator and Milena Ivkovic's *Planning Disrupted* webinars, explore the new virtual public space for exchanging knowledge and opinions on urban and regional planning. With Dushko Bogunovic as chair and Kate Holmquist as secretary, our recomposed Scientific Committee is increasingly providing 'food for thought as reflection'. Additionally, we actively initiate and participate in webinars and online workshops with our partnering organizations like UPSC, SACPLAN, ISUH, OECD, Urban Economy Forum and UN HABITAT.

Despite all of this year's disruptions, ISOCARP remains a vibrant organization. New members are joining, membership renew is strong, registrations to our first virtual World Planning Congress are very promising, and we have received a stunning number of candidate nominations for the upcoming Board elections. ISOCARP remains a worldwide members-led network association of urban and regional planners.

Every year our members meet at our annual congress to participate in a wide array of activities such as publications, workshops, awards, and training programs. This learning network is the greatest asset which the Society provides to its members. Our members meet, connect, get to know each other, learn from each other, and support each other with ideas and through the exchange of knowledge and experience. In addition, the ISOCARP Society is supported by the ISOCARP Institute, which provides members the opportunity to share their expertise by volunteering to participate in projects such as: ISOCARP Institute Research projects (EU/global), ISOCARP Institute Practice projects (UPAT, YPP, Technical Assistance), and ISOCARP Institute Academy projects (training, capacity building, webinars).

Finally, ISOCARP's annual publication, *Review of International Planning Practices*, provides a platform to learn about noteworthy real-world projects undertaken by our global network of city and regional planners, academics, place makers, landscape architects, community workers, politicians, economists, and everyone else who is involved in making better cities. The themes of our annual World Planning Congresses and of the "*Review…*" always have been forward looking, exploring new themes and topics in our discipline. My sincere gratitude and appreciation go out to all authors, editors Jim Reilly and Mahak Agrawal, graphic designer Ricardo Moura, and to Malgorzata Hanzl, the Board Member of ISOCARP, in charge of publications.

Editors' Foreword

Welcome to this edition of ISOCARP's premiere publication – this year with a new name! What would have been the *ISOCARP Review 16 – Post Oil Planning*, is now the *Review of World Planning Practice – Volume 16: Post-Oil Urbanism*. We like the new name, *Review of World Planning Practices*, as it more clearly declares the Society's intention to publishing noteworthy city and regional planning efforts from around the world. Finally, we use the term "Volume" to highlights the annual Congress-specific topic of interest.

In this publication we present 14 articles organized into three sections: Post-Oil Urbanism; Development Policy, Research and Theory; and, City and Regional Planning Practices. As usual, our articles record planning efforts in resource rich and poor places and present how the focus of planning changes from place to place. Finally, we offer a review of the 2019 Gerd Albers award winning book as well as summary descriptions of the 2019 ISOCARP Award for Excellence winning projects.

New to *Volume 16* is the preponderance of articles about policy implementation planning. In past issues we have published grand large-scale physical planning projects such as master plans for a city, region or resource with their lovely colored suitability, transportation and other analysis maps. This year most of our articles document the implementation of more ethereal international, national and regional policy goals such as those to promote sustainable growth or reduce greenhouse emissions. In large part, these articles tell the story of promoting local stakeholder cooperation and collaboration to define and achieve local physical and behavioral changes. When one considers the daily work that planners do in real life, most effort is directed towards plan implementation rather than master plan development.

We want the "*Review*" to document all aspects of international planning. This is why we welcome this mix of articles about theory, research, master planning and plan implementation. With these articles, we hope to provide a balanced sampling of the work performed by our members and a more balanced blend of big-picture and local implementation efforts.

As usual, the stars of this publication are the authors of our articles. Please take the time to read about them in our "About the Authors" section.

Finally, please acknowledge and welcome Mahak Agrawal's promotion to Editor. Four years ago, Mahak began to work on the Publication staff. Since then she has masterfully carried out all tasks requested of her and has assumed increasing responsibility. For example, this year she coordinated all contact with our authors as well as managing much of the internal publication effort. She is always cheerful and willingly devotes the time to get the job done properly. Her effort enabled Jim Reilly, an Editor since *Volume 10*, to reduce his workload as he fights long term neurological illnesses.

We hope you enjoy reading the Review and find our collection of articles interesting and useful in your daily practices.

A challenge to all city and regional planners
Think Piece commisioned by the International Society of City and Regional Planners

Think Piece initiated by Ali Alraouf, co-authored by Ali Alraouf, Malgorzata Hanzl and Dushko Bogunovich; and co-edited by Jeremy Dawkins and Frank D'hondt, all members of the Board of the International Society of City and Regional Planners (ISOCARP). Although commissioned by ISOCARP Board, this Think Piece does not imply the expression of opinion on the part of ISOCARP as an association of individual and institutional members.

The COVID-19 pandemic marked the year 2020 with one of the biggest public health crises of all time, threatening to take away millions of lives. It is poised to instigate a massive economic crisis, triggering further negative consequences for human life, wellbeing and lifestyle. Cities, especially the globally significant ones – such as Wuhan, Milan, Madrid, Paris, London, New York, Los Angeles – have been disproportionally affected. Thus, the pandemic is evolving into an urban crisis, forcing us to reconsider our deeply held beliefs about good city form and the purpose of planning. We face a time of unprecedented change and uncertainty, with the urban environment under the spotlight. During the pandemic, we need to adjust our role as planners, but more importantly, we need to re-examine the urban planning agenda in the 'post-COVID-19 world'.

The International Society of City and Regional Planners invites planners around the world to consider the post-Coronavirus future of our regions, cities and towns. Here we initiate and facilitate a discussion regarding planning challenges, goals and constraints. We are aware of the ancient wisdom that a crisis is also an opportunity. We embrace the challenge to reinvent the meaning of our mission: Knowledge for Better Cities.

Towards that end, members of the International Society of City and Regional Planners (ISOCARP) have formulated several initial questions, starting with what we have learned from the still-unfolding drama of the Coronavirus, and moving to more speculative, future-exploring questions:

- How have cities enabled – and contained – the pandemic?
- How can we expect cities to recover once the pandemic has peaked?
- Is there a model of the city which is 'pandemic-resistant'?
- How does the pandemic relate to the issue of resilience in general terms – resilience to climate change, natural hazards, accidents, war, unrest…?
- Is the question of a 'post-COVID-19 city' one of public health only, or a broader matter of safety, security and survival in the face of all possible risks – and abrupt climate change in particular?
- When considering pandemics and other crises and emergencies, should planners focus on the physical form (size, shape, structure, density) and the material elements of the city (infrastructure, buildings, open space) only, or should they also take action on the economy, society, culture, governance, politics…?
- What types of urban innovation can we expect, or promote, based on the lessons learned during the COVID-19 crisis?

ISOCARP's 56th World Planning Congress, set for Doha from 8 to 12 November 2020, will provide an excellent platform to discuss these and other questions arising from the pandemic health crisis, including links with the pre-defined general Congress theme of 'Post-Oil City – Planning for Urban Green Deals'.

Profound issues are raised in the current crisis. We here propose a number of themes as prompts for a broader and deeper discussion.

The Risks of Globalisation and the Emergence of 'Glocalisation'
The COVID-19 pandemic has revealed the fragility of 'globalisation'. While it triggered attempts to return to self-centred national states and even self-sufficient cities and regions – along with disturbing expressions of nationalism and xenophobia – it also produced constructive examples of international collaboration and the sharing of information, know-how and supplies.

Smart Protection vs Fear of Surveillance
Some strategies to combat COVID-19 come straight from the intelligence toolbox, tracing individuals and their contacts. How do we distinguish the strategic advantages of big data and smart urban management from the dangers of personal surveillance and the end of privacy?

Digital Platforms as a Viable Communication Tool
The crisis has empowered digital platforms, from distance learning to virtual conferencing and online shopping. Will reduced physical mobility (of goods and people) equally empower the transition to a 100% clean energy society?

From Planning Cities to Sustaining Community
The crisis confirms that planning is not just about the physical aspects of a city but also about the engagement of its people. Citizens are using social networks to get engaged voluntarily, generating social capital. Should city planners and designers get out of their offices and engage with the locals even more than before?

The Size of the City or the Neighbourhood Unit
Should we still celebrate the concept of mega and metropolitan cities? Urban villages can be isolated and protected more easily than huge cities. Moreover, they foster a sense of belonging and dynamic social interaction. Urban planners should promote subregions efficiently connected via public transportation while internally enjoying a high degree of self-sufficiency.

Changes to Transportation Modes
Pollution levels in cities all over the world have plummeted. Air quality is healthy again. Transformed mobility patterns affect our daily lives – citizens switch to walking and give up driving. Shall we see this process as a threat equal to the collapse of the global economy or do we need to learn how to stick to these practices in the Post-COVID-19 world?

Acting on the Climate Crisis
Do people, governments and political systems act only when a threat is personal and immediate? Why doesn't the world treat the existential threat of climate change like an infectious disease?

City Planning in the Age of a Global Economic Crisis
As millions lose their jobs some countries, such as Spain, consider introducing a basic income. Another strategy is urban agriculture, to guarantee that no-one goes hungry while generating fuel and fibre – and reducing household bills.

Contemporary Cities and the Housing Dilemma
Suddenly it's possible, in many countries, to stop evictions and foreclosures, and to suspend payment on mortgages for primary residences and utility bills. Could some of these extraordinary measures be retained after the pandemic in cases of poverty, job losses and similar hardship?

Social Justice and Just Cities
Urban planners need to identify and promote infrastructure that (i) prevents the most vulnerable populations from being the prime victims of epidemics – most likely involving a dramatic change in development priorities – and (ii) addresses the problems of global migration and post-war conditions.

Social Distancing: Can Public Life Survive Coronavirus?
Whereas the current coronavirus fight requires social distancing and isolation, proximity and density make many urban systems more efficient, while lower density enables access to nature and local resources. In the wake of the pandemic, we will seek an integration of higher and lower densities, rather than extolling the virtues of one or the other.

The Biggest Questions: A New Paradigm?
Would a less consumerist society, with fewer possessions and less travel, need a different urban setting? Will local industries prosper and replace global supply chains? Will societies have more solidarity, or less? Will local communities be more engaged? Will governments be held more accountable? What other transformations of urban cultures can we expect, and how can we retain and improve them through planning and design?

ISOCARP AWARD FOR EXCELLENCE 2019

The ISOCARP Award for Excellence (AfE) recognizes superior urban and regional plans, at any phase from design to fully implementation. Nomination can be submitted by professionals and institutions who are invited to submit different tools used in planners' daily practice: normative plans, strategic plans, urban projects, programs, policies, research works, software, smart tools facilitating planners, etc. This prestigious award is bestowed in two categories: Grand Award and Merit Award.

In 2019, seven eligible entries were submitted:

1 Guangzhou Tianhe Central Business District: Comprehensive Improvement Action Plan, by AECOM, China;
2 ShapingSEQ: South East Queensland Regional Plan 2017, by Ethos Urban, Australia;
3 Urban Design and Master Plan Update for Nansha Bay Area, Guangzhou, by ISA Internationales Stadtbauatelier, China;
4 From DEPRESSIVE to IMPRESSIVE: The Comprehensive Plan for Generation of Coal Subsidence Area in Huaibei Downtown, by Nanjing Southeast University Urban Planning & Design Institute, China;
5 Integrated Design in Weihai: Digital Urban Design in High-Density and Ecological Sensitive Metropolis, by Nanjing Southeast University Urban Planning & Design Institute, China;
6 Strategy masterplan of urban transition of Turkistan City, by Urban Sustain Architects, Kazakhstan; and,
7 People-oriented Public Participatory Planning: Successful Practice of Public Space Improvement in High-density Urban Areas in China (Jianghan District of Wuhan), by Wuhan Land Use and Urban Spatial Planning Research Center (WLSP), China

The jury was composed of four experienced professional planners: Jens Aerts (US), Abdelwehab Alwehab (Iraq), Pedro Ressano Garcia (Portugal), and Siniša Trkulja (Serbia). The evaluation process was demanding due to the quality of entries and the diversity in terms: challenges and issues faced, themes and vision, environmental issues, and finally scale (from regional, metropolitan, to urban level).

2019 Grand Award for Excellence Winner

Strategy masterplan of urban transition of Turkistan City, by Urban Sustain Architects, Kazakhstan

The urban transition of Turkistan City is an ambitious plan for both the historical city core and the new city district, covering more than 1,600 ha. Based on a long-term innovative and interdisciplinary strategy, the development priorities and key projects illustrate comprehensive and balanced development of the metropolitan area including elements such as: heritage conservation and creative industries to boost the cultural capital of the old city district; new business, administrative and tourist centers to create urban hubs at the outskirts of the old city; and finally, given severe ecological issues, various bioclimatic techniques at different typological scales are used to enrich the biodiversity, restore the water biotopes and riparian forests, and protect the city from dust, salt, wind and overheating.

Visualization of Old City. Source: Urban Sustain Architects + Frame Art.

2019 Merit Award for Excellence Winner

People-oriented Public Participatory Planning: Successful Practice of Public Space Improvement in High-density Urban Areas in China (Jianghan District of Wuhan), by Wuhan Land Use and Urban Spatial Planning Research Center (WLSP), China

The Jianghan District of Wuhan, as a typical urban downtown in China, lacks building stock and faces high urban density. Under such challenges, the project objectives – to stimulate the regional urban vitality and enable local people to enjoy the unique landscape – are very ambitious and socially significant. The project offers a clear methodology for analysis, strategy development and implementation actions, which can be successfully applied to other similar cases. However, its greatest asset is an intersectoral, interdisciplinary and 'citizen science' approach, which clearly calls for innovations in terms of both governance procedures and digital tools.

Public Space Quality in Jianghan District of Wuhan. Source: WLSP.

Gerd Albers 2019
Book Award

Modern Rome:
From Napoleon to the Twenty-First Century

by Italo Insolera
edited by Lucia Bozzola, Roberto Einaudi and Marco Zumaglini
Cambridge Scholars Publishing, 586 pp, £80.99

Book Review by Ana Perić

Modern Rome: From Napoleon to the Twenty-First Century – a masterpiece on the urban planning of the Italian capital during the 19th and 20th centuries – was first published in 1962 by Italo Insolera, a renowned expert in urban studies. He specialised in the relationship between archaeology and modern urban planning, taking due account of local culture as exemplified by a variety of environmental organisations and public movements. After fifteen editions, the most recent volume published in 2018 by Lucia Bozzola, Roberto Einaudi, and Marco Zumaglini, has received a wealth of improvements: it contains news and updates on the urban planning of Rome at the beginning of the 21st century; the text is brought to life with maps, plans, and photographs; and, most importantly, the book has been translated into English, allowing it to reach a broad audience interested in the history of the Eternal City over the last two centuries.

The main value of this seminal work in the field of historical urban studies lies in the profound scrutiny, proven methodology, and scientific objectivity with which it approaches the complexity of the factors that have influenced specific urban forms and patterns in one of the most fascinating cities in the world. As a result, this history of Rome's urban development is much more than a plain description of a successful preservation of its past. On the contrary, the volume meticulously reveals the close relationships between different socio-political circumstances which were often considered the main cause of chaotic and ineffective urban planning in the modern history of Rome.

The book is divided into three core parts. Prologue succinctly introduces the most important editors' points relevant for Anglo-Saxon readers. Modern Rome, the body of the work based on Insolera's latest edition of 2011, opens with Rome as Napoleon's 'second city of the empire' and reflects on Rome as the capital of the Papal States and then of a united Italy, first under the monarchy and subsequently fascism and the Republic of today. Epilogue addresses the challenges of the Eternal City as seen by Insolera's contemporaries. It is accompanied by substantial graphical material, a glossary of urban planning terms, and a historical overview of the institutional framework. Although the book can be read in different ways (for instance to explore particular districts, initiatives, or the most influential names that have shaped the development of Rome), for the purpose of this review I have divided the central chapters into six periods: 1811–1845, 1846–1870, 1871–1906, 1907–1921, 1922–1960, and contemporary Rome.

Insolera views 1811 as the beginning of the modern era of Rome, mainly as this year saw the adoption of the city's first urban planning rules (in the form of three decrees), signed into law by both Napoleon and his prefect de Tournon, who is considered the first urban planner of modern Rome. The transformation of the city of Rome into a modern capital was made possible by the spirit of the French revolution, oriented as it was towards social justice whilst abandoning feudal restraints. Accordingly, the decisive directions for urban reform were Culture and Society, which were to change not only the formal structure of Rome – through excavations of the Forum of Trajan, the Coliseum, and the Trevi Fountain, as well as a proposal for large-scale archaeological parks – but also the city's social and economic organisation. For the first time in history, the city builders were paid workers. However, Napoleon's downfall in 1814, followed by the re-establishment of the Papal States, dealt a blow to democratic values and, despite restorations of the Coliseum, the Pantheon's piazza, the Arch of Titus, and the Piazza del Popolo, all inspired by de Tournon's visions for lifting the veil on the ancient city, Rome became 'the stalest city in Europe'.

Despite the turbulence caused throughout Europe by the Revolutions of 1848, Insolera perceptively recognises 1846 as the next milestone in the urban transformation of Rome. The Pope elected in that year, Pius IX, had an important counterpart in his minister de Merode. A pragmatic administrator, de Merode believed that a central railway station was the core of any modern city and more important than religious and political centres. Accordingly, in 1863, the Termini Station was designated as the junction of all railway lines. The foundation of the Kingdom of Italy in 1861 did not change de Merode's role as the great urban planner of the future capital of the country: he developed streets and divided up building lots, completed construction works, and tasked municipalities with providing all the services (such as sewerage and lighting) necessary to make each new district habitable.

The unification of Italy brought immigrants from Piedmont, Tuscany,

Abruzzo, and Sicily, who influenced the culture of Rome that became the national capital in 1871, as decided ten years earlier. An administrative centre was developed, initially mainly focused on the districts around the Via XX Settembre, but government buildings later haphazardly sprang up all across Rome. For Insolera, the inability to translate ideas into regulations and legislation is a typical characteristic of Roman administration, with dire consequences: in the absence of planning instruments, corruption was able to flourish, leading to imbalance between, on the one hand, large landowners (mainly banks and insurance companies), and, on the other, poor immigrants from Southern Italy and Romans displaced from the historic centre. As a result, during the Umbertine period (1878–1900), renaissance and baroque villas were destroyed to create a new transport infrastructure, while the new suburban slums (*borgate*) grew on the outskirts of the city.

Insolera's story highlights the year 1907, when Rome elected its first mayor outside the land-owning circle. Taking advantage of Prime Minister Giolitti's planning laws, the programme of Mayor Nathan was aimed at restricting building speculation and land monopolies through a system of taxes on sites zoned for construction. According to Insolera, Sanjust's 1909 Urban Plan is considered the best in recent Roman history, as it takes due account of public transport, district design, and building typology. Piazza Verbano, for example, built according to this plan, has remained a vibrant square throughout its history. However, good governance did not last long. In 1914, the new bourgeois administration, together with the conservative aristocracy, set aside all proactive and modern regulations to make a construction fever possible again. The global crisis caused by the World War I helped negate the legacy of the former city fathers.

The next phase in Rome's urban history began with the rise of fascism in 1922. The following two decades saw a destruction of the historic city centre, together with the eviction of lower-class residents to the suburbs of dubious legality. Determined to create a Grand Rome and ignoring cultural heritage safeguards, Mussolini surrounded himself with unelected governors who came from the landowning elite and legitimised illicit ad-hoc speculation in land. Into these confused circumstances there came a man with a vision: Virgilio Testa, the head of the Roman administration. Insolera rightly recognises him as the third major urban planner of modern Rome for his most important proposals, the expansion of Rome towards the sea (1928), the monumental E42/EUR district, and the so-called 1942 Shadow Plan. As Testa remained in office until 1960, surviving the fascist regime, he gradually implemented all the elements that had previously only been designed for elites – the 1950 Jubilee and the 1960 Olympics far exceeded the Duce's original ideas.

In the closing decades of the 20th century, Rome faced a large-scale defeat of urban planning. The 1960s were a clear example of the urban planning tradition at its best: architecture took precedence over urban planning as social practice. The next decade saw major urban sprawl, which even exceeded the actual needs of the Roman population. The 1980s and 1990s were the decades of struggle between urban planning and its socially relevant objectives, on the one hand, and urban planning as a mere tool of neoliberalism, on the other. In addition, urban development in the new millennium is caught between the need to protect cultural heritage and the challenges of multiethnicity. Insolera ends his ground-breaking work on a rather pessimistic note, by placing an emphasis on politics and its restraining influence: when ideology dictates goals and mechanisms, there is not much room for socially relevant urban planning.

The reading of this well-written, in-depth and informed chronicle was above all an exciting journey through Rome. Leading the reader through the phases of Rome's urban history with astonishing ease, Insolera's vivid narrative of complex networks of people, institutions, politics, culture, and physical spaces will appeal not only to planning enthusiasts, but also to the general public eager to learn about the turbulent last two centuries of Roman urban development. The lesson is clear: only by learning about the obstacles of the past can we do our best to proactively address future challenges in a final attempt to make our cities as resilient as possible to the coming uncertainties. And today's challenges go beyond ineffective planning, health concerns, or climate crisis: instead, Insolera emphasises 'the break with civilization', which leads to unprecedented individualism, ignorance of social values, and, finally, a loss of identity. In his interpretation, this break with civilization means a break with culture in its broadest sense. As demonstrated in various historical periods, the neglect of culture, exemplified here as archaeological heritage, has served as an overture to some of the darkest times of recent Italian history, whilst the glorious epochs of Italian society were ushered in by culture, cosmopolitan spirit, and multi-culturalism. The latter seems to be the key element from which future Rome can finally draw new, invigorating life and meaning.

Dr Ana Perić, who trained as an architect and urban planner, is lecturer at the Institute for Spatial and Landscape Development of ETH Zurich. Devoted to exploring spatial planning for development, she has participated in several projects on various topics, from transnational cooperation to brownfield regeneration initiatives. Her current interests revolve around planning cultures and territorial governance in Europe.

POST-OIL URBANISM

Beyond Oil: The Inevitability of Knowledge-Based Urbanism in Middle Eastern and Gulf Cities

Ali A. Alraouf

The oil-based urbanity which is based on the image of global cities investing in skyscraoppers and real estate fantasies, the case of Abu Dhabi City (Image by author)

INTRODUCTION

The common understanding of planning and cities evolution suggests that cities develop organically over hundreds of years. This was not the case for most Gulf cities. In the last few decades, contemporary Gulf cities expanded rapidly in terms of size, urbanity, infrastructure, and population. For example,during the last decade Gulf cities have become magnets attracting people seeking better working opportunities from almost every part of the world. Workforces with different skill levels, backgrounds and ideologies are pouring into Gulf cities.

The economical, political, social and cultural changes which took place during the last decade suggest that radical changes are needed to cope with the aspiration of nationals, particularly those of the young generations from the Middle East. The protests of the youth[1], which started in Tunisia at the end of 2010 and travelled through the Middle East all the way to Bahrain, emerged from the lack of decent life, absence of social justice and lack of dignified sense of citizenship. People in most Middle Eastern cities realized that they were manipulated and betrayed. As a result, the rich Middle Eastern countries, basically located around the Arabian Gulf, become fully aware of the necessity to diversify their economical bases to provide more employment and quality of life opportunities for this population segment.

While most Middle Eastern cities share a common language and religion, contextual differences are very radical. Hence we need to understand how cultural, social, and economical factors will facilitate or hinder transforming Middle Eastern cities. While these nations have been trying to move from an oil-based economy, the idea of developing a more multi-dimensional, knowledge based economy has been seen as a solution to their social and political problems. (Alraouf, 2008).

KNOWLEDGE-BASED URBAN DEVELOPMENT (KBUD) IN THE MIDDLE EAST

The KBUD concept first emerge in the urban planning and development during the last decade of the 20th century (Ergazakis et al., 2006). The concept aims to increase the region's competitive edge by attracting highly skilled human resources and investments, which in turn would supply the people of the region with associated jobs enabling them to reaching a higher standard of living and welfare.

KBUD is based on the premises of a Knowledge Economy (KE) which plays a crucial role in the competitiveness of cities and urban regions (Yigitcanlar and Lönnqvist, 2013). Knight (2008) argues that knowledge-based urban development is a social learning process in which the knowledge capital is utilized in the development of a sustainable urban region. Kunzmann (2008) characterize the knowledge-based urban development concept as a collaborative development framework that provides guideline to the public, private and academic sectors regarding the make-up of future development strategies that attract and retain talent and investment, as well as to the creation of knowledge-intensive urban and regional policies. Yigitcanlar (2011) looks upon KBUD, in the era of the global knowledge-based economy, as a novel development paradigm, which aims to create economic prosperity, social order, sustainable environment and appropriate municipal governance.

The conceptual structure of KBUD is based on integrated set of pillars (Carrillo et. al., 2014; Yigitcanlar, 2011; Alraouf, 2008). These economic development pillar sets the knowledge-based employment as the centre of economic activities because, according to this concept, knowledge is not a supplementary factor of development but a key resource. The socio-cultural pillar aims to

Figure 1: The world first Solar plane's in its round-the-world flight started from and returned to Abu Dhabi marking the irrelevance of oil in the near future as an energy source even for air transpportation.

improve people's knowledge to to insure they secure these new jobs leading to a knowledge-based society, with main characteristics of strong human capital, acceptance of diversity and social equality. The third pillar is the environmental and urban (enviro-urban)development which aims to find harmony between preservation and improvement of the built and natural environments, thus insuring a positive spatial sustainable development and quality of life and place needed to attract knowledge workers and to establish a knowledge milieu. The fourth, final pillar, is the institutional development which aims to form a group of local actors who - in cooperation with stakeholders - determine the common future vision and plan its implementation strategy. Thus, the fourth pillar is about the development of a knowledge-based governance, that can provide the effective institutional background that is essential for design and implementation of the development (Yigitcanlar, 2011).

As a result of coordinated development of the four dimensions an appropriate social, environmental, institutional and economic climate will develop, that will create economic prosperity, social equity, and environmental sustainability. As suggested in recent research, many cities and regions that have not chosen a knowledge-based development pathway are facing the imminent risk of being left behind, diminishing and perishing (Yigitcanlar, 2011; Carrillo et al., 2014; Alraouf, 2018).

Developing KBUD cities in the context of Post-oil Gulf States is controversial. While some argue that it represents a fundamental crisis for the Gulf, an alternative argument suggests that it is totally the opposite (Alraouf, 2017). This alternative view argues that the inconvenient truth of oil depletion and decreased prices may be a blessing to the Gulf States if this historic opportunity is used to reconsider how government funds are spent, society lifestyles might be affected, modes of production revised, the culture of consumption and social integration revised. Therefore, as a number of Gulf and Middle Eastern cities turn towards the knowledge-based industries,major consequences are expected to Gulf cities' planning, urbanism and architecture.

As (Engelke, 2015) argues when it comes to building the knowledge economy, the Gulf is one of the most ambitious regions in the world. Recognizing that their countries' fossil-fuel-driven wealth will come to an end in the future, leaders of the six Gulf Cooperation Council (GCC) countries are investing heavily in the infrastructure necessary to create economies driven more by inno-

vation than by energy exports. To address obvious discrepancy in research, scientific development and knowledge production, certain Middle Eastern leaders have turned to knowledge hubs and innovation clusters intended to concentrate local and international entrepreneurs and offer the resources to incubate their ideas.

THE POST CARBON ERA: A NEED FOR AN ALTERNATIVE URBANISM

All Gulf States came to the conclusion that a focus on development strategies for a post-oil paradigm was essential. Therefore, the principles of a knowledge economy were declared the visioning backbone for the following long term plans: Bahrain 2030, Dubai 2030, Abu Dhabi 2032, Qatar 2030, Kuwait 2035 and Riyadh 2025.

Recently, the importance of education and the creation of a Creative Class are seen as strategically important for the future development of Middle Eastern and Gulf cities. For the "Qatar National Development Strategy"the main goal is to build on knowledge: "As Qatar's economy diversifies more from its reliance on gas and oil, success will increasingly depend on the ability to compete in a global knowledge economy. Educating and training Qataris to their full potential will be critical to continuing progress" (GSDP, 2011, p. 122). In the "Dubai Strategic Plan 2015" two knowledge-based aims are described: (1) "Preparing Dubai's workforce for the high-value, knowledge-driven economy, which requires attracting and retaining highly skilled employees, improving Nationals' qualifications and increasing their motivation" and (2) "Turning Dubai into a vibrant science and technology hub in targeted sectors, by supporting the development of existing sectors, and establishing the right environment for nurturing the post 2015 economy" (Dubai Strategic Plan, 2007, p. 22). Other emerging cities in the Gulf, mainly Doha, Dubai, Abu Dhabi and more recently Riyadh are trying, in different capacities, to transform from their previous status as oil producing economies to cities celebrating education, research, innovation and attracting knowledge workers.

For this process to thrive, a different kind of urbanism is required. The needs of knowledge workers moving to Gulf cities will change the spatial contents, boundaries and qualities of these cities. (KBUD) can be an appropriate vehicle towards a new planning paradigm for Gulf cities. New patterns of urban spaces should be articulated. The ultimate goal is to increase the innovation and creative capacity of cities based on a new set of knowledge patterns.

The main dilemma of some Middle Eastern cities' struggling to establish a knowledge and creativity identity is related to the notion of time. As the pioneer work of Castells and Hall (1994) and Hall (1998) concluded, building innovative or creative cities was a long and slow, sometimes excruciatingly slow, process, and that the outcome could by no means be guaranteed in advance. There are favourable preconditions, to be sure, but they are difficult to achieve and their presence will not automatically generate the desired outcome. Further, creating these preconditions is itself a long process. This conclusion is of crucial importance if the aim is to build a truly creative city full of cultural interactions, inspiration and continuous knowledge dissemination.

In this sense, we need to differentiate between cities built for cultural consumption versus the ones built for culture production; the latter aspiring to become a genuine creative city. If the creative city is more related to the production of culture, then the point is that cities have to start with something. They have to discover their best points and build on them. Further, they have to engage the local community and not only focus on cultural tourism. The existing social and cultural base is essential for cities to incubate creativity

Figure 2: Gulf cities are witnessing the dawn of a new urban paradigm centered on KBUD, the case of NYU in Abu Dhabi overlooking the city's global urban skyline (Source:Author)

Figure 3: New York University in Abu Dhabi, one of the evidences of new urbanity in Gulf cities aiming towards establishing knowledge and creative cities (Source: Author)

to ensure economic growth, urban development, and socio-cultural and psychological well being of their residents. Cultural resources are embodied in people's creativity, and Landry (2000) highlights that knowledge cities aim to create the conditions for people to think, plan, and act creatively.

Florida (2002) looks at the importance of place and how it affects everything from job opportunities to economic prosperity to relationships and networks. Place is becoming more relevant to the global economy and our individual lives. The choice of where to live is arguably the most important decision we make, as important as choosing a spouse or a career. Landry (2000) argues Cities need creativity to retain the high performers who have lived there for years as well as to attract new, interesting residents. In his analysis culture needs to move to centre stage and we need to focus on the cost of *not* thinking about creativity, culture, design, art and heritage.

THE CHALLENGE OF ATTRACTING KNOWLEDGE WORKERS

For a direct understanding of the knowledge-based society, cities need to recognize that Knowledge will be its key resource and knowledge workers (KW) will be the dominant group in its Workforce. A knowledge-based society is defined as "one where knowledge diffusion, production and application become the organizing principle in all aspects of human activity: culture, society, the economy, politics, and private life" (UNDP, 2003, p. 2). Therefore, the economic success of such a society is related to the ability of a place to attract the creative class, and that 'quality of place' is a key factor.

Members of the 'creative class' are thought to prefer lively and mixed environments, excellent urban infrastructures and cultural facilities (Florida, 2002). Knowledge workers (KW), as important individual agents who embody, exchange, create and exploit knowledge, contribute to regional competitiveness and growth (Thierstein et al., 2017). Urban and regional planning has displayed a recent interest in designing policies to attract international investment and encourage economic growth in KCs. These policies also focus on creating social amenities and communities to attract knowledge workers (Martin, 2001; Chen & Choi, 2004). The key factors in attracting knowledge workers to KCs are mainly social relationships and quality of life provided (Mathur, 1999; Leamer & Storper, 2001; Robinson, 2002; Santagata, 2002). Hence, it is necessary to have a better understanding of their fundamental spatial needs particularly in housing choices, workplace environments, and commute choices. The spatial choices of Knowledge Workers as Thierstein et al. (2017) argue, are related to diversified residence alternatives, stimulating working environments and reliable public transportation as they tend to use it to allow for more social interactions and reflections on ideas and concepts. Knowledge creation has become unrestricted and is no longer bounded to the physical workplace (Thierstein et al., 2017). The notion of (KW) acquires a distinct importance in the context of Gulf cities as the demographic structure shows clearly the majority of expatriates moving to work and life in cities around the Gulf.

Hence, a crucial question is what happens if the knowledge is not transferred to nationals? The creation of a knowledge economy of which entrepreneurship is a key component, is hugely important to the economic growth of the Middle East. But it is vital that knowledge is transferred to and shared by locals rather than residing only with expatriates who are likely to take the knowledge outside the country once they travel back. Creating opportunities for local-level business to interact with international corporations is hugely needed.

GLOBAL OR KNOWLEDGE CITIES: THE NEW DYNAMICS IN CITY FORMATION AND TRANSFORMATION

The discussion on the transformation from global to knowledge cities is relevant to cities in the developed world, only limited number of Middle Eastern cities aspires for a global position. Therefore, a distinction between global and knowledge cities is crucial for evaluating the contemporary status of Middle Eastern cities.

A major misunderstanding characterized the attempts of some Middle Eastern cities to claim being globalized. As numerous researchers suggest, Gulf cities, in their attempt to gain a place on the global stage, focused on the imagery nature of globalization (Al-Nakib, 2016; Alraouf, 2017; 2010; Wippel, 2014; Fromherz, 2012; Wiedmann, 2010). Hence, the construction of skyscrapers similar to the ones in New York and Chicago was more important than investing in the real components that would construct a knowledge city. While cities like New York, Chicago and Hong Kong are full of skyscrapers but this is

not the reason for putting them on the top of global cities. Planners and decision makers in the Gulf were not able to see the other layers needed to label a city as a global one.

Sassen (1991), identifies four major interrelated functions that cities should perform in their attempt at becoming global. Cities should become "highly concentrated command points in the organization of the world economy; second, as key locations for finance and for specialized service firms, which have replaced manufacturing as the leading economic sectors; third, as sites of production including production of innovations, in these leading industries; and fourth, as markets for the products and innovations produced" (pp. 3-4). Hence, Sassen (2000) elaborates that cities in the information age should be re-perceived as nodes of an immense network of cultural, commercial and political transactions.

SCRUTINIZING THE REGIONAL MODELS OF KBUD

In a post-global and a post-oil paradigm, most of the Middle Eastern cities are thriving to diversified their industries. Enormous investments, which used in the last decade to finance iconic real estate developments, are now shifting towards planning and financing knowledge based economic centres. Additionally, unprecedented concerns regarding the production and dissemination of information and knowledge are rising within all of those cities.

A knowledge city as clearly clarified earlier, becomes a geographical territory with an expanding knowledge society, and with knowledge as a strong pillar of its economy. However, the concept of Knowledge City familiar in Western countries is merely interpreted in the Middle Eastern context as a geographical concentration of Special Economic Zones (SEZ's) and I.T. Companies. This has

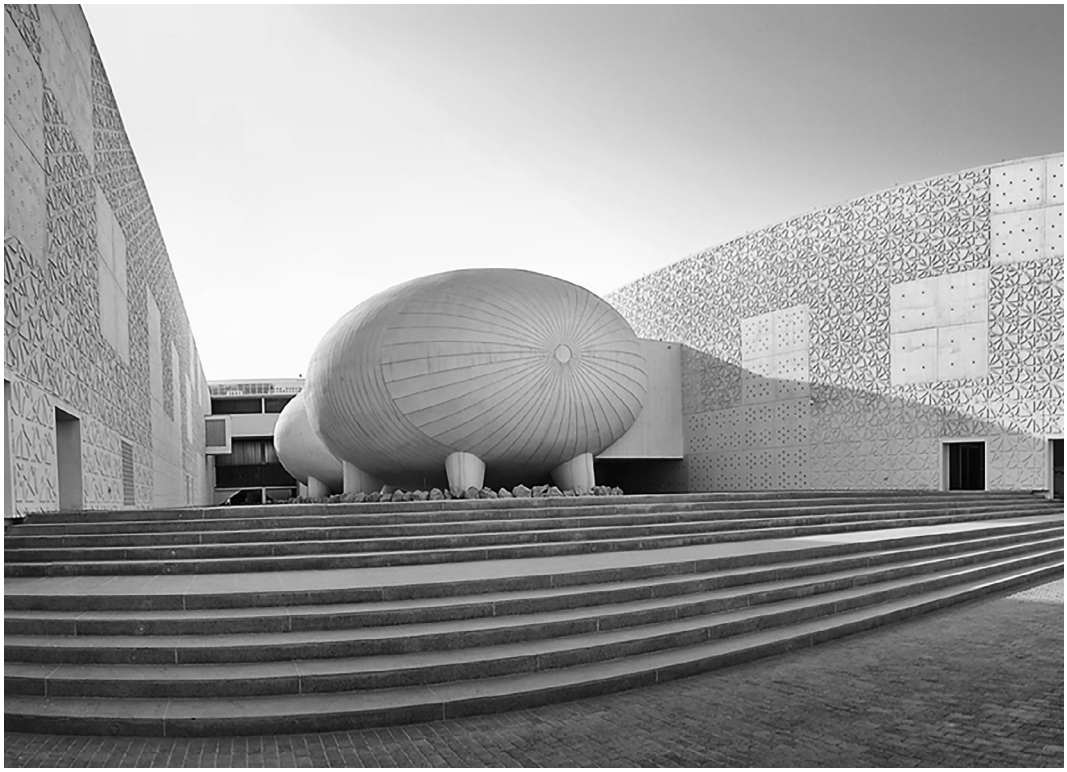


Figure 4: Weil Cornell Medical School designed by world-renowned architect Arata Isozaki, Contemporary in concept, the design nonetheless features many references to traditional Islamic and Gulf architecture from geometric patterns on exterior and interior walls to wind towers in the courtyard(©Alraouf)

Figure 5: The new National Library (QNL) designed by Rem Koolhaas who stressed the openness and publicness of the library and created strong connectivity with the urban setting, community and the city(©Alraouf)

Figure 6: The Collage of Islamic Studies and Education city mosque allocated on the border of EC and attracting city dwellers to perform prayers and enjoy the adjacent parks, an example of using architecture as a tool for learning and knowledge dissemination (Source: Courtesy of QF.org).

led to the development of various "Knowledge City" areas, which merely consist of several knowledge based and knowledge intensive industries. However, one needs to realize that the SEZ's, I.T. companies and the other industries, are an integral part of the city of knowledge, and by themselves do not constitute a Knowledge City[2].

In this section, selected cases from the Gulf Statas are described, with particular attention to influential cases from the Middle Eastern.

Emirate of Dubai

The Emirate of Dubai initiated a number of projects in the direction of KBUD, but were more centralized and divorced from the real community. Both the Media city (DMC) and the Knowledge Village (KV) projects in Dubai failed to construct a knowledge pole (Alraouf, 2005). Today DMC is becoming the headquarters of foreign media agencies and KV is transformed into rental places for modest universities branches, collages or training centres.

Part of the substantial criticism directed to projects like Knowledge village or Dubai internet city(or Media city) is their role as merely business parks and

Figure 7: Knowledge Village (KV) in Dubai is an example of how KBUD can be implemented in a distorted way (Source: Author)

not innovation clusters. For example, Dubai Internet city was established in the Dubai Technology and Media Free Zone, a tax-free commercial site set up to support the development of knowledge-based industries. Over the past decade, Dubai Internet City has been developed to provide a complete business and community infrastructure for ICT companies. There are now 16 office buildings in Dubai Internet City. The buildings are set amidst an exquisitely designed landscape of lakes and gardens.

Emirate of Abu Dhabi

Abu Dhabi, the capital city of the UAE, also is seeking prominence on the global stage with the $28 billion Saadiyat Island project. This development is a cultural island that accommodates a campus of New York University, franchises of the Louvre and Guggenheim museums, and other leading cultural institutions in an attempt to capitalize on the 'Bilbao effect', garner international credibility, and attract further foreign investment (Ponzini & Nastasi, 2011). Other interesting knowledge-based educational institutions in Abu Dhabi include the Khalifa University for Science, Technology and Research (KUSTAR), and the Masdar Institute of Science and Technology (MIST). KUSTAR is a science-focused university, and was established in 2008 as an "independent, non-profit coeducational institution, dedicated to the advancement of learning through teaching and research and to the discovery and application of knowledge" (KUSTAR, 2008). KUSTAR is known for its Khalifa University Robotics Institute (KURI) which is dedicated to establishing an internationally recognized centre of excellence in Robotics research and ICT Innovation Centre. Meanwhile, Masdar Institute of Science and Technology (MIST) was established in 2009 in Abu Dhabi "to be a world-class graduate-level institution, seamlessly integrating research and education to produce future world leaders and critical thinkers in advanced energy and sustainability" (MIST, 2010).

Bahrain

As early as 2006, the State announced the launch of a $1 billion Science and Technology Park plan in Bahrain (Alraouf, 2007; 2008). The world-class park to host small, medium, and large technology companies to grow niche markets, and attract global science and technology companies to the Kingdom. This initiative is to boost and encourage innovation in technology and scien-

tific research, while providing a solid infrastructure for the development of the technology sector in Bahrain. The project will be executed in three term phases. The first phase will focus on the infrastructure of the project, with the second and third phases on development of science laboratories, educational partnerships and lifestyle aspects. The project will provide jobs and help establish Bahrain as the science and technology hub of the region. This initiative will attract two types of projects; technological, and scientific research and development. The target sectors for the new park include new technologies, such as clean technology, renewable energy, environment, information and communications.

Unfortunately, and after more than a decade, the project still in an ambiguous status as it was delayed because of the financial crisis in 2008 and then due to the instable political situation resulted from 14 February - March 2011 uprising erupted to confront claims of discrimination against Shias, unemployment, slow pace of democratization and Inspiration from the Arab Spring and concurrent regional protests (Murphy, 2011; Alraouf, 2013; Shehabi and Jones, 2015).

Oman

Muscat, while essentially focused on tourism, initiated a KBUD projectby declaring the establishment of a science park named Knowledge Oasis Muscat (KOM). The park was opened in 2003 and built to encourage technology-oriented and thus knowledge-intensive businesses. As the project site suggests, KOM symbolizes successful public-private partnership in nurturing knowledge-based businesses. KOM is committed to creating an environment in which budding entrepreneurs, small and medium-sized enterprises and established multi-nationals can coexist, innovate and flourish within a Middle East setting (www.kom.om).

Today, the science park consists of over sixty companies, and even two IT-Colleges are located in the Knowledge Oasis Muscat (Al Shmeli, 2009). Controversially, KOM is an excellent evidence of how KBUD was seen within the Middle East as a fashionable development trend without the required understating of the nature of such projects and commitment to achieve it. While the project represents itself as a science park and research oasis, in reality, it is just a building with very limited activities in research and knowledge-based activities and is geared more to real estate investment where companies rent spaces.

Egypt

In Egypt, an isolated city for scientific research called Mubarak Scientific City was inaugurated in August, 2000. It was located almost 200 km from Cairo and was built to promote a new knowledge era for Egypt. Three month after the outset of Mubarak in 11th February 2011, the title of the project was changed to City of Scientific Research and Technological Applications (SRTA-City).

Cairo's experience in building the Smart Village project, as a model for KBUD, deserves attention. The project,located almost 40 km away from the Cairo's city centre,was intended to impart a high-tech identity about the future of Egypt. However, both public access and the allocation of open spaces was denied. Therefore, the village is totally isolated from both the city and the community. Even architecturally, a naive reproduction of Pharaonic (Ancient Egyptian) architecture was created. Although international giants like Microsoft and other major ICT companies move their local headquarters to the project, their presence stressed more the isolated nature of the project (Alraouf, 2005; 2007). Security issues are becoming a top priority limiting the accessibility of the project especially when two years ago the Egyptian ministry of Information

Figure 8: City of Scientific Research and Technological Applications (SRTA-City) (Source: Author)

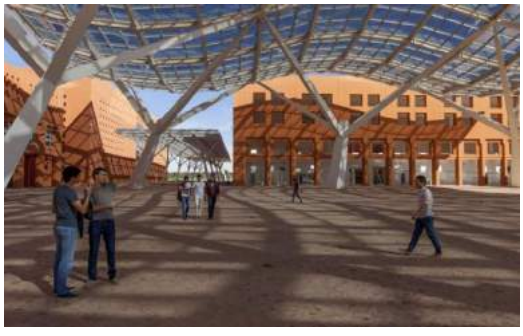
and Communications moved to the village's central zone. Currently, the reality of Smart Village is far from the concept of KBUD and more close to a gated business park disguised in a Pharaonic architectural costume.

Morrocco

Inspired by Masdar city in Abu Dhabi, the State declared the start of the first Green City in the country and Africa. The city, named King Mohamed VI Green City, is located between Casablanca and Marrakesh, adjacent to Benguerir, an existing city of 80,000 people. The city's intended population is 120,000 with an area of 10 square Kilometers with anticipated economic drivers mainly being higher education and research. The aim is to be a development engine, incubator and research hub centred on universities, and research and development activities. The Mohammed VI Polytechnic University, within the city, is designed to attract high quality candidates from around the world to produce a thriving new sociocultural "engine" for the city. It is a hub for research, training and innovation, and a real bridgehead between Morocco, Africa and the world. King Mohammed VI, on January 12, 2017 inaugurated the first phase of the project, mainly the new university.

Safouane (2015) argues that King Mohamed VI Green City represents a transformational change in a non-crisis mode that will provide an all-encompassing make-over of not only Benguerir, but the region as a whole. The Green City project has the aspirations of shifting the role of the city, namely from one focused on phosphate development and mining, to one that will promote education and a knowledge-oriented ecosystem.

Figure 9: The Mohammed VI Polytechnic University



Saudi Arabia

Another controversial context for establishing KBUD within the Middle East is Saudi Arabia. The State hosted the first international Symposium on Knowledge Cities ever held in the Middle East in Al-Madinah Al-Munawarah in 2005. At this event the cities leaders and planners were able to get a closer look at the holistic understanding of establishing KCs and KBUD (AUDI, Saudi Arabia, 2005).

The first major attempt to transform a Saudi city into a knowledge city was documented in Abu-Anzeh and Ledraa(2007. The narrative of Riyadh, the Saudi capital, proved that establishing a knowledge city is not only about attracting the physical entities including ICT centres, universities and research institutions. As Abu-Anzeh and Ledraa (2007) argue, Riyadh enjoys many of world class city characteristics which make the city well integrated in a networked global economy. They claim that the city is striving towards greater openness, creating a vibrant environment that attracts talented people and providing workers with the incentives both to explore and to exploit technological possibilities (p.131).While an excellent urban environment is a must for any knowledge city that cares to attract and retain knowledge workers, scrutinizing the meaning of openness and intellectual freedom is a must in a severely conservative context like Saudi Arabia. If Riyadh is to assert itself as a knowledge city, it must embark on making every effort to develop transparent, democratic, diversified and tolerant environment which would credibly attract knowledge workers from all over the world.

The second revealing case in Saudi Arabia is King Abdulla Economic City (KAEC) and University of Science and Technology, which were established to declare the move towards a post-oil era in the future development of Saudi Arabia. In an attempt to learn from the limitations faced the trial to transform Riyadh into a knowledge city, KASTC is based on the concept of providing unprecedented compromises within the conservative Saudi context. KAEC has looked to Singapore as a model, seeking to emulate the city state's strong international economy, its port as a major source of revenue, and its use of public–private investment strategies in order to nurture a knowledge economy, develop advanced manufacturing, and attract global talent (Moser, 2014a). KAEC features six distinct zones: a university, an industrial zone, a business district, a resort area, a sea port, and residential areas. The Saudi government bills King Abdullah Economic City and the economic cities as a solution to diversify the economy away from oil and provide a comparatively relaxed and liberal way of life. Given the unique context of a private, socially liberal gated city located in a combination of an absolute monarchy and Islamic theocracy, many questions emerge about how the city will operate on a day-to-day basis upon completion Moser et al. (2015).

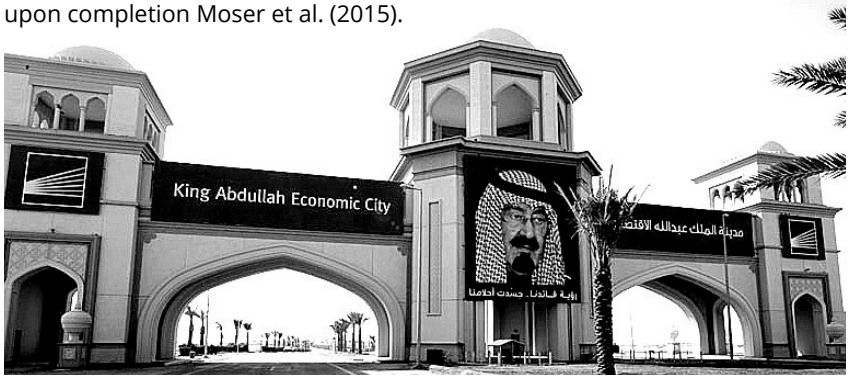


Figure 10: KAEC is publicized as a new paradigm in Saudi Arabia urbanity and development (Image by author)

KAEC's relationship to the rest of the Saudi kingdom is likely to create social and political tension. KAEC is already publicized as a unique context for more relaxed and westernised social norms. For instance, women were permitted to drive, men and women are allowed to associate in public, women are not required to wear the legally mandatory black traditional "Abaya" or the head scarf "Hijab" when in public.

As construction in KAEC proceeds rapidly, questions about its future continue to increase. There is a high level of ambiguity regarding how KAEC will become socially integrated or separated from the rest of the country. Applying radically different sets of social values within the same country or city would emphasize the isolation and fragmentation of the KBUD. KAEC could represent a new era of social change and liberalization in Saudi Arabia(Moser et al2015). It might be perceived as inviting the whole of Saudi Arabia, and not just the walled project, into a different social and cultural paradigm transforming the conservative kingdom into a cosmopolitan, global context that prioritizes innovation, youth and creativity over unchanging parochialism. In fact, Moser et al. (2015) warn that without such social transformation, KAEC could easily become yet another example of neoliberal development that places corporate interests above all else and strengthens the ruling elite's hold on society.

Strategies to develop

The previously discussed of cases in the Middle East, illustrates the validity of KBUD for the reinventing of cities aspiring for an alternative development scenario. Clearly some main pillars of KBUD still need more consideration, like a democratic approach to development and transparency in the decision making process. Participatory mechanisms and collaborative methodologies to incorporate diversified pool of stakeholders need more elaboration and consideration in the development process.

Additionally, discussing strategies to activate the role of knowledge workers and allowing the creative class to contribute to urban development reveals two distinct scenarios. The first is a top down approach based on a political decision taken from top leaders supported by the appropriate financial resources. Such approach was practiced in Middle Eastern cities by activating political power in some cases or exploiting financial resources in other cases particularly Gulf cities. In Morocco, Tunisia, Sudan and Egypt, political leaders imposed projects to gain credibility. Also, as it was observed in most of the Gulf States, this approach is highly adopted. Evidently, in all cases the State's national vision based on the vision of the leader and use his name as a reference need invest unconditionally in architectural glamour to attract global brands and. The model of Dubai would appear as a prime case in this category. In the Middle Eastern and Gulf context, Dubai used architecture extensively to construct a city brand by building controversial global landmarks like the highest tower on earth, Burj Khalifa or the Palm real-estate and recreational projects.

The second strategy requires a more liberal and democratically structured society which would allow a more grass roots and bottom up approach to engaging knowledge workers and creative class. The second alternative is based on shaping an appropriate tangible context where the knowledge economy will perform. In this approach, architecture, design and technology are used to attract strategic brands, highly educated individuals, and high added value services. Another documented scenario is based on the Fabrication of a city brand with one major art or architecture initiative. The case Bilbao and the Guggenheim museum designed by Frank Gehry and its impact on the pros-

perity of the city is a classic example. In the case of Bilbao, it is the city that activated a substantial mobilization by the city council to engage in a transformational process. This process, which took about two decades, helped transform the city from post-industrial decay to a thriving culture and knowledge based economy. The post-oil Middle East requires Strategies driven from the ground. A more organic process which would allow the community members to participate in decision making and planning decisions. Such approach moves from focusing on isolated projects to initiate an urban development process of district, neighbourhoods and city improvement and rejuvenation.

Conclusion

The narrative recited in this chapter suggests that any attempt towards establishing a contemporary Middle Eastern Knowledge City should acknowledge its holistic nature. KC is a comprehensive organization; it is a place where knowledge is produced and spread all over its parts. As seen in most of the claimed KBUD or KCs projects in the Middle East, the challenge is to shift Middle Eastern /Gulf cities' strategies towards creating a holistic knowledge cities rather than scattered, fragmented and isolated projects, is fundamentally required. Hence, for the establishment of contemporary Knowledge Cities in the Middle East, two integrated conditions are required. The process of creating Middle Eastern knowledge cities should be shifted from focusing on creating isolated and separated knowledge centres based on the presence of ICT centres or higher education facilities to a process by which a knowledge network is established and shared by different sectors of the community.

Research is also a prerequisite of a KC. It requires infrastructure of research, an issue which has not been developed in the Middle East. Hence, an inclusive initiative to prepare the grounds for a major transformation must be translated into strategy.

This chapter analysed the context of KBUD within the paradigm of the post-oil economy and the Middle Eastern cities formation and transformation. The major challenge in the Middle East is to fully comprehend that knowledge and creative cities are complex entities, and attempts to transform cities into knowledge cities would likely result in failure unless they are guided by holistic strategic visions. These strategic visions should incorporate KBUD policies for attracting and retaining knowledge workers and industries and also empowering citizens as knowledge creators and innovators. Planning for KBUD of cities requires a holistic approach to development which would include socio-economic development, urban development, and governance, political stability, democratic environment, freedom, investing in intellectual capital and urban diversity. Planning for KBUD also requires understanding that there is no ideal blue print for a knowledge city but different formal and spatial configurations based on the local context and embedded potentials. KBUD needs a move from a focusing on a single project within the city to a large number of connected zones, clusters and environs all of which are physical and intellectual manifestation of KBUD principles and policies primarily political and societal will.

In a post-carbon paradigm, KBUD should be perceived as the opportunity for new sustainable growth and prosperity in the global knowledge-based economy. Therefore, the emerging knowledge cities in the Middle East should be seen within a regional and global knowledge network. The ultimate goal is to increase the innovation and creative capacity of cities based on a new set of knowledge patterns. However, in order for promising and emerging Middle Eastern cities like Doha, Abu Dhabi, or Dubai to become inspirations of Middle Eastern culture and be truly considered as centres of the Middle East, they

must engage in culture creation and production rather than adoption and appropriation. These cities must involve in the creation of art, the production of knowledge, the publishing of scientific research, and the exchange of social and political discourse, if they are considering being KBUD models and centres of the Middle East.

For a holistic KBUD to be attained, a number of integrates and inseparable conditions need to be planned and implemented. Principally, strategic vision and dynamic log-term development plan coupled with political and societal determination and good governance and supported by strong financial investments from public and private sectors. Secondly, on the level of place making, KBUD requires multi-cultural character of the city, worldwide diversity, and admirable quality of places, affordable housing and urban services, just environment and democratic atmosphere. It promotes urban connectivity and accessibility to all community facilities specifically knowledge-based and technologically advanced. KBUD is about creating an affordable and attractive way of life and not exclusive a lifestyle geared only for the wealthy sector of the community. It calls for tolerating human diversity and being socially just and equitable. Thirdly, KBUD is about the creation of urban innovativeness engines, unique research culture manifested in research-based universities, research and development institutions and continuous and sustainable development, social upgrading and capacity building for all citizens. Finally, establishing the needed legal infrastructure to protect intellectual property. Without well-defined rules and regulations, people will be discouraged from innovation and creative contributions. KBUD is a form of development which is based on the ultimate respect for nature and therefore, it is an eco-friendly form of development. It promotes sustainability in all its aspects particularly the concern for the future generations. In sum, KBUD is human and nature oriented holistic strategy for growth evidently applicable to the context of the Middle East if holistically comprehended.

Endnotes

1 Also documented as the Arab Spring.

2 Alraouf (2008) provides critical analysis of the first attempts to create knowledge based urban developments within the Middle East.

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Rebuilding Delfzijl: Recovering from Earthquakes Inducted by the Extraction of Natural Gas

Martin Dubbeling

De Hoaven van Delfziel

Al het mien boot gain stuurhut
Gain mast en ook gain kiel
Ik wil mit die veur d'anker
In d'Hoaven van Delfziel

(Ede Staal, 1941-1986)

The Port of Delfzijl

Even if my boat has no cabin
No mast and also no keel
I want it to anchor
In the Port of Delfzijl

Figure 1: Drone photo of the Port of Delfzijl. Source: Eemsdeltadrones, Municipality of Delfzijl.

INTRODUCTION

The port city Delfzijl (25,000 inhabitants) is situated in Groningen (584,000 inhabitants), the north-eastern province of the Netherlands. Surrounding the city is the Groningen gas field, discovered in 1959. This is the largest natural gas field in Europe and the eight-largest in the world. Since 1986, rapid and extensive exploitation of this gas field has caused well over 1,400 small and damaging earthquakes in the region[1]. Delfzijl is situated close to Loppersum, the epicentre of these continuing earthquakes. The effect of these earthquakes, described as a "disaster in slow motion[2]", sparked a fierce national political debate and has drawn international media coverage[3].

As a result of these earthquakes, nearly all public buildings (schools, libraries, healthcare institutions, and churches) and thousands of houses have been declared unsafe and need to be renovated or demolished and rebuild in the next few years. This massive rehabilitation project triggers both challenges and opportunities to improve the urban fabric and to transform the port city Delfzijl into a sustainable and more liveable city. This inevitable restructuring of the city and settlements in the neighbouring municipalities of Appingedam and Loppersum also requires a fundamental strategy on public participation and participatory urban planning and design.

This article describes the challenges of planning, design and the rapid transformations of Delfzijl in the context of dynamic, demographic and economic uncertainties.

ABOUT DELFZIJL

Delfzijl is a port and industrial city, surrounded by historic landscapes and villages, at the Eems Estuary now part of the Wadden Sea UNESCO World Heritage Site that extends over the northern coasts of The Netherlands and Germany and the western coast of Denmark[4]. The settlement was created around 1300 AD when the first of several canals with sluices and sea locks were built as part of the regional water system and to improve the connections by ship between the city of Groningen and the sea. Due to its strategic position, Delfzijl was one of the fortified cities in defence of the northern coast of the Netherlands between 1580 and 1875. After the demolition of the fortifications and the construction of new waterways, railway lines and motorways, Delfzijl became the maritime centre of the northern part of the Netherlands, first with shipbuilding, brickworks and sawmills and later with cargo shipping, stevedoring, offshore, towage, transport and lifting.

After the discovery of salt and natural gas in the region in the 1950s, Delfzijl became an industrial port with a strong chemical cluster and an aluminium plant. Around 15% of all the chemical products that are produced in the Netherlands come from Delfzijl. The chemical cluster Delfzijl is a sustainably developed industrial area for chemical related companies, connected to each other like a chain. The industries, governments and knowledge institutes in the region work together towards a shared ambition: changing the nature of chemistry[5].

Since 2009, several large wind and solar parks are in operation to meet the increasing demand for green electricity. With the green energy mix provided by wind turbines, solar fields, biomass and hydropower (from Norway), and the opportunities offered by the agricultural hinterland, Delfzijl became a major bio-based location in North-West Europe. Waste is used increasingly as a raw material for the chemical sector or is turned into energy. The circular economy and bio-based industries now play an important role in Delfzijl, which is rapidly turning into the preferred location for mechanical and chemical recycling and waste industry[6].

Figure 2: Damages caused by earthquakes on a farmhouse in Lageland, 20 kilometres from Delfzijl. Source: Kees van de Veen.

Figure 3: Drone photo of the historic centre of Delfzijl. Source: Eemsdeltadrones, Municipality of Delfzijl.

Figure 4: Drone photo of Delfzijl North, near the Wadden Sea and the centre of Delfzijl. Source: Eemsdeltadrones, Municipality of Delfzijl.

The chemical industries, the enlargement of the sea locks, broadening the *Eemskanaal*[7] , combined with the construction of outer and inner port basins, attracted more industries and more laborers which resulted in a rapid urban development of Delfzijl. In the 1950s and 1960s, as the economic prospects were grand and compelling, the Province of Groningen commissioned the development of a second industrial port to the north of Delfzijl, the Eemshaven. Also, Delfzijl and its neighbouring municipalities made preparations to build a series of new towns for more than 100,000 inhabitants between the two ports, starting with the development of Delfzijl North.

Delfzijl's growth increased an average of 500 inhabitants every year, from 25,000 inhabitants in 1960 to almost 35,000 in 1980. After 1980, due to economic recession and the restructuring and automation in the industries, employment declined. Consequentially, the number of inhabitants dropped back to 25,000 in 2020. This residual population is expected to reach 20,000 inhabitants in 2030, due to aging and demographic decline.

This population decline has affected the demand and quality of the housing market. Between 1995 and 2010 several thousands of relatively newly built houses needed to be demolished. A second round of restructuring the housing stock in the near future cannot be ruled out. The changing population has also caused a negative impact on the spatial and social perception of Delfzijl. It now is a city with an abundance of infrastructure, partially derelict and underused industrial areas, a distorted urban fabric and many left-over areas where residential areas were developed, built and transformed into green spaces without a clear use or purpose.

However, Delfzijl hopes for a better future, especially after optimistic figures that the population fell by only fifty inhabitants in 2019, the smallest decrease since 2002. In his 2020 New Year's speech mayor Gerard Beukema expressed his hopes for growth in the future sparked by the hundreds of houses that will be renovated or rebuild. But first the inhabitants have to bite the bullet. "All construction work will cause tensions and inconvenience. But those who want to be beautiful must suffer pain. We want Delfzijl to be recognized and valued again as a municipality where it is not only good work, but also good housing and accommodation[8]".

Rebuilding Delfzijl comes with additional challenges and opportunities. Delfzijl can take advantage of this huge restructuring by redefining its relation to the Eems, the Wadden Sea, the many water connections and its port as well as upgrading the overall resilience and attractiveness of the city. It is a multi-layered operation that includes the active involvement of its citizens, and the accelerated anticipating on climate adaptation and energy transition, which is needed more than ever now the extraction of natural gas from the Groningen gas field inducted the damaging earthquakes.

THE GRONINGEN GAS FIELD

The Groningen gas field is operated by the Nederlandse Aardolie Maatschappij BV (NAM), a joint venture between Royal Dutch Shell and ExxonMobil with each company owning a 50% share. Natural gas at this field is extracted through drilling, a process which can cause earthquakes as the ground settles.

Since the start of the gas extraction, earthquakes exhibited an exponential growth with time. On 16 August 2012, the heaviest induced earthquake in the Netherlands, with a magnitude of 3.6, occurred with its epicentre only a few hundreds of metres below the surface of Huizinge, 20 kilometres from Delfzijl. While seemingly moderate in magnitude, the sheer number of hundreds continuous earthquakes act as a physical stressor to living conditions and give an

adverse outlook to the long-term structural integrity of homes and buildings[9].

The continuous sequence of small earthquakes has affected thousands of houses[10] and nearly all public buildings (schools, libraries, healthcare institutions, churches, sporting facilities) in the Eemsdelta region. Technical assessments indicate that these houses and public buildings need to be renovated or demolished and rebuild in the next few years as they are unsafe. The damages and collateral effects of the earthquakes inducted by the extraction of natural gas are monitored and assessed by the National Coordinator for Groningen. This is a collaboration of the Groningen municipalities in the earthquake zone, the Province of Groningen and the Central Government. The task of the National Coordinator for Groningen is not only to reactively repair the damages, proactively reinforce homes and other buildings, but also to enhance the quality of life and sustainability and to reinforce the regional economy[11].

After protests in Groningen, the Dutch government decided in 2014 to cut output from the gas field and pay those affected by the earthquakes a compensation worth 1.2 billion Euros, spread over a period of 5 years[12]. In 2018 the government announced it would shut down the gas extraction entirely by 2030 to limit seismic risks and for safety reasons. Recently (2019) The Dutch government announced a further acceleration of the decommissioning of the field, stopping all regular extraction of natural gas by 2022, eight years earlier than initially planned[13]. Consequentially, two hundred of the Netherlands' biggest companies have been requested by their government to stop sourcing fuel from the Dutch gas fields within four years following a series of increasingly significant earthquakes[14].

Ending the extraction of natural gas by 2022 is a very hard decision as the Groningen gas field is regarded as one of the corner stones in the energy supply of north western Europe. On the other hand, this development is a significant accelerator and game changer in the necessary transition of the energy production and energy infrastructure in the Netherlands, with opportunities for economic development and the sustainable transformation of the built environment. According to the 2019 National Climate Agreement seven million homes and one million buildings, many of which are moderately well insulated and virtually all of which are heated by natural gas, will be insulated, converted to use renewable heating and will use and generate clean electricity by 2050. This process will be carried out incrementally and will involve cooperation of residents and owners of these buildings[15].

CHALLENGING CHANGES IN THE NETHERLANDS

Meanwhile, the Netherlands Ministry of the Interior and Kingdom Relations[16], all twelve provinces, 21 regional water authorities, and 355 municipalities in the Netherlands are preparing to implement the new Environmental Planning Act (Omgevingswet). This Act seeks to modernize, harmonize and simplify current rules on land use planning, environmental protection, nature conservation, construction of buildings, protection of cultural heritage, water management, urban and rural redevelopment, development of major public and private works and mining and earth removal. It proposes to integrate all these rules into one legal framework.

It is expected that the Environmental Planning Act will enter into force and take effect in 2022. It shifts of responsibilities from ministerial authorities to provinces and regional water authorities, and from provinces to municipalities. All levels of government need to prepare for unprecedented changes in governance, responsibilities and operations.

Through this Act the government intends to combine and simplify the reg-

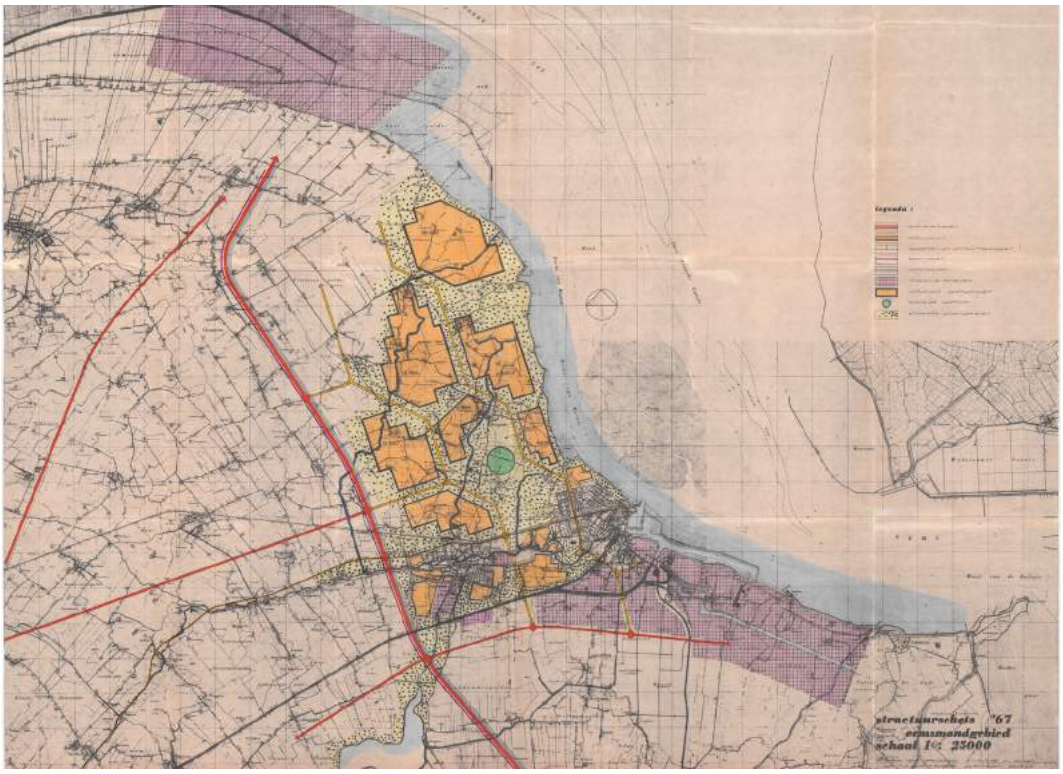

Figure 5: Spatial Strategy New Towns for 100.000 inhabitants North of Delfzijl, 1967. By Bureau voor stedebouw ir. R. Hajema, Assen, and bureau ir. P. Oom and Kuipers, Groningen. Source: Archives Municipality of Delfzijl.

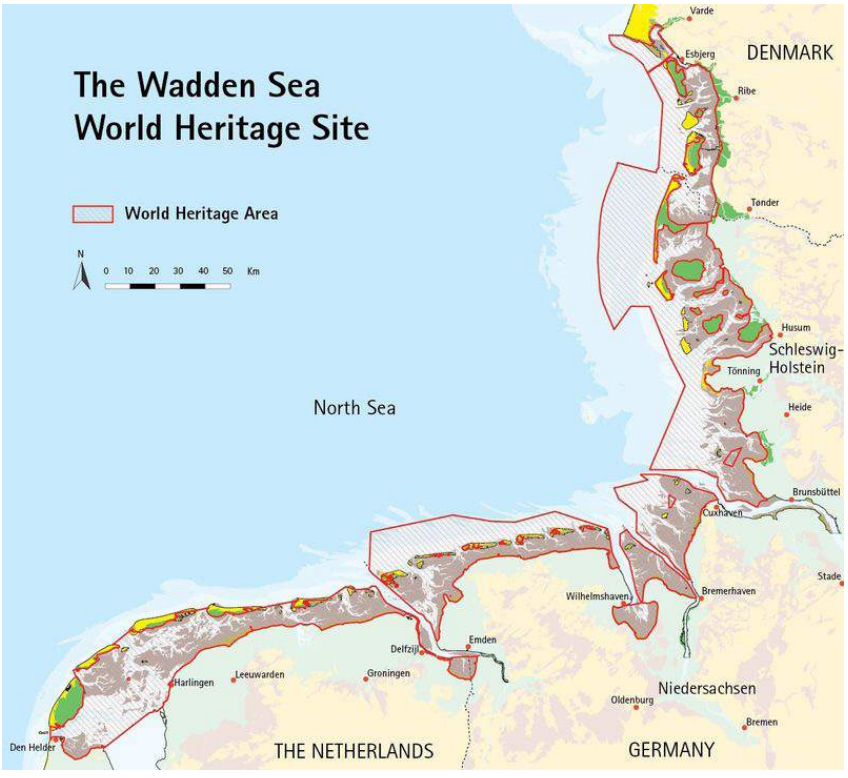

Figure 6: The Wadden Sea is the largest tidal flats system in the world, where natural processes proceed largely undisturbed. Nowhere else in the world is such a dynamic landscape with a multitude of habitats, shaped by wind and tides. Source: https://www.waddensea-worldheritage.org.

ulations for spatial projects. The aim is to make it easier to start up projects such as the construction of housing on former business parks, or the building of wind farms. Current environmental legislation consists of dozens of laws and hundreds of regulations for land use, residential areas, infrastructure, the environment, nature and water; each has their own starting points, procedures and requirements. This makes the present environmental and planning legislation too complex and time consuming for municipalities that have to work with it. The new Act will replace fifteen existing laws, including the Water Act, the Crisis and Recovery Act and the Spatial Planning Act. The provisions of eight other laws will be transferred to the Environmental Planning Act as well[17].

The (draft) National Strategy on Spatial Planning and the Environment (*Nationale Omgevingsvisie* - NOVI) is the spatial policy strategy based on the Environmental Planning Act. The National Strategy on Spatial Planning and the Environment replaces the National Policy for Infrastructure and Spatial Planning (2011) and provides a sustainable perspective for both the built and the natural environment. It defines and sets a course to fulfil national interests through 2050. Those interests are clustered in four priorities: 1) Space for climate adaptation and energy transition, 2) Sustainable economic growth potential, 3) Strong and healthy cities and regions, and 4) Future-proof development of rural areas.

The intention is that the National Strategy on Spatial Planning and the Environment will be adaptable to new developments, in a permanent and cyclic process. The approach is a shared responsibility of the central, provin-

Figure 7: Detail from one of the maps with characteristics of the city of Delfzijl. Source: Manual with Characteristics Landscapes and Settlements of the Municipality of Delfzijl. Knowledge Centre for Spatial Quality and Cultural Heritage in the Build Environment Libau, commissioned by the Municipality of Delfzijl (Draft 2020).

Figure 8 (top): Map with an overview of the transformation of the residential areas in Delfzijl North and the northern part of the historic centre. Source: Municipality of Delfzijl.

Figure 9 (bottom): Drone photo of the urban transformation opportunities along the canals of Delfzijl. Source: Eemsdeltadrones, Municipality of Delfzijl.

cial and municipal governments working together as one body. The National Strategy on Spatial Planning and the Environment was drawn up in consultation with the responsible Ministries, provinces, water authorities and municipalities. Input was also sought from advisory boards, centres of knowledge, the private sector, civil society organizations and individual citizens. The dialogue with and between all these stakeholders will not cease when the (draft) NOVI is published. It will remain an open process of which public consultation represents an intrinsic part[18].

Delfzijl also is an active and strategic partner in defining the Groningen Regional Energy Strategy. Groningen is one of the 30 energy regions in the Netherlands that contribute to the National Program of Regional Energy Strategies. The National Program aims to implementation of the National Climate Agreement (2019), the Dutch elaboration of COP21, the international Paris Agreement on climate change, greenhouse gas mitigation, adaptation and finance (2015). All 30 energy regions are requested to significantly reduce CO2 emissions by 2030, to half the levels found in 1990. Another cooperative project is to investigate where and how best to generate sustainable electricity on land (wind and sun) and to determine which sources feasibly can be used to supply heat to neighbourhoods and buildings instead of using natural gas. In a Regional Energy Strategy, each energy region describes its own choices[19].

Delfzijl has much to offer to the Groningen Regional Energy Strategy as the city has developed itself as a major energy cluster. The chemical and waste industries produce enormous quantities of residual heat and multiple wind and solar parks are located in and around the port of Delfzijl. Future extensions of these wind and solar parks are now in preparation.

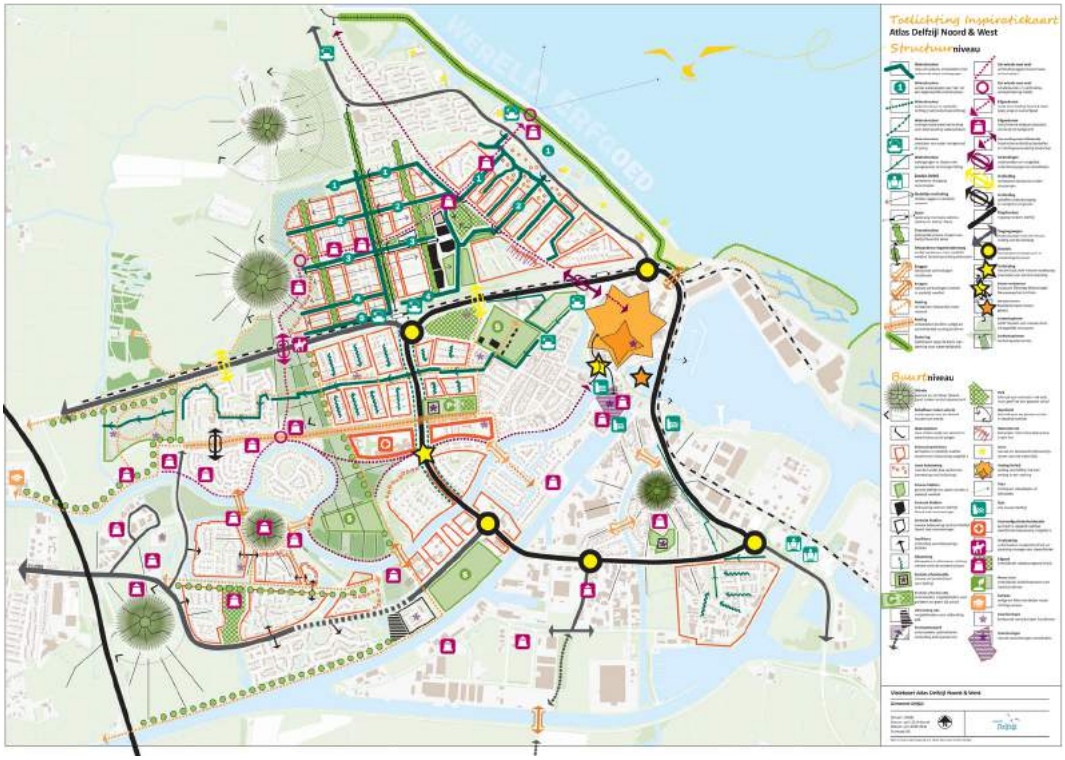

Figure 10: Inspirational strategy for the transformation of Delfzijl, the result of multiple intensive workshops. Source: Eemsdeltadrones, Municipality of Delfzijl.

PLANNING FOR A DYNAMIC EEMSDELTA

Delfzijl's decline in population and the administrative reform of municipal governance in the Netherlands has led to the situation that, in 2021, the Municipality of Delfzijl will merge with two neighbouring municipalities, Appingedam (11,500 inhabitants) and Loppersum (9,500 inhabitants), that also are severely affected by earthquakes. The new municipality (46,000 inhabitants) will carry the name of Eemsdelta, referring to its location on the Eems Estuary, part of the Wadden Sea. This merger will make that the new municipality is better equipped to deal with the earthquake damages. It is expected that in few years well over 3,000 houses will be demolished and rebuilt[20].

In the midst of this perfect storm of rapid changes and developments, the municipality had no other choice than to prepare and implement new policies, kick start urban renewal and residential redevelopments and communicate with its inhabitants about the necessary and compelling changes within a timespan of five to ten years. This inevitable restructuring of residential areas and public buildings in Eemsdelta requires a fundamental strategy on public participation and participatory urban planning and design. It also evokes challenges and opportunities to improve the urban fabric and to transform the port city Delfzijl into a more sustainable, attractive and compact city.

Delfzijl will be overhauled in the coming years. To start with, more than 600 new houses will be built at twenty plus locations. Schools, care facilities, the library and theatre will also be rebuilt. "Delfzijl soon will turn into a large construction site", according to mayor Gerard Beukema. By far the largest project is the demolition and rebuilding of 527 houses in Delfzijl Noord. Due to the earthquakes, the houses do not meet the safety standards. Full renovation of these houses is not an issue as the calculated costs will surpass the current real estate value. All affected residents get the opportunity to rent or buy a new home at other locations in newly developed residential areas. The reinforcement operation of the renovation and rebuilding houses and public buildings does not stop there. According to Beukema, "The total program contains more than 5,000 houses in our municipality. That is more than 40 percent of our housing stock, which is a huge task for Delfzijl[21]."

In the neighbouring settlements Appingedam and Loppersum demolition and rebuilding houses in situ has proven to be troublesome as residents resent to move to temporary houses and move twice within 9-18 months. The municipality of Delfzijl, however, has chosen to build these 527 houses on the vacant and available plots first and subsequently demolish the damaged houses that are left behind. As these plots are available from previous redevelopments between 1995 and 2010, this can be done quite rapidly and efficiently without having to build temporary houses. The need for the rapid renewal of its cultural cluster with the centre of the arts, the library and theatre, however, forced the city to double its efforts and pace to redevelop, improve and intensify the core and fringes of its inner city.

The Eemsdelta area will receive 82 million euros from the National Coordinator for Groningen in compensation of the damages. An important goal is to stimulate employment, but that is, according to Beukema, insufficient. "Extra efforts are needed to guide people who live in this region to access the labour market. Increased efforts are also needed in the field of education, training and supervision. Starting in Delfzijl Noord, to give children from disadvantaged backgrounds a better future[22]."

The challenges and opportunities of rebuilding the port municipality are obvious. The requires a roadmap on public participation and mobilizing the inhabitants and communities to improve and upgrade the quality of life and to

Figure 11: Images from workshops to build a better Delfzijl. Source: Municipality of Delfzijl.

Figure 12: Participatory design sessions at the townhall meetings in Delfzijl. Source: Municipality of Delfzijl.

transform Delfzijl into an attractive, safe, sustainable and healthy city. Building back a better Delfzijl offers an additional impulse to make the historic city centre of Delfzijl more compact and to renew the functional relation and spatial experience with the waterfront on the Eems Estuary and the Wadden Sea UNESCO World Heritage Site through placemaking[23].

With so many projects and developments, the tailwind of urgency, ample budgets and additional and specialized staff, the inhabitants can be easily forgotten. But in Delfzijl the inhabitants are well informed, represented and activated. Delfzijl prepared and hosted numerous town hall meetings, dedicated workshops with many actors and stakeholders, discussion evenings, and participatory design sessions and will continue to do so. In November 2019, the Municipality of Delfzijl hosted the first of a series of expositions and housing markets for its citizens. The purpose of these two-day events is to enable local housing association and developers to proactively inform and to receive feedback from potential tenants and home buyers about the new developments and to bring supply and demand together. The first event in November 2019 attracted over 2,000 visitors[24]. For the second event in June 2020, during the COVID-19 pandemic, all information was shared and exchanged through a dedicated website, social media and with billboards on the twenty plus locations[25].

The Environment and Planning Act requires and challenges provinces and municipalities to draft their own regional and local strategies on spatial and environmental planning. In preparation, the municipality reassessed its almost lost and forgotten characteristics and qualities of its cultural heritage of landscapes and villages. This has been documented in a manual, a living document that will updated on a regular basis. The Municipality of Delfzijl also prepared an 'Opening Statement' for the Delfzijl Strategy on Spatial and Environmental Planning that describes five ambitions: 1) Innovative demographic transition, 2) Leading the way in energy transition, 3) Making space for water, 4) Balancing between economy and residents, and 5) Improve accessibility and connectivity of Delfzijl. The Opening Statement outlines Delfzijl in 2020, indicates the tasks for 2030 and offers a future perspective to 2040. In addition, it examines the main outlines and the spatial consequences of the tasks and themes for the inner city, the port and the northern and southern landscapes and villages of the municipality.

Figure 13: Images from workshops to build a better Delfzijl. Source: Municipality of Delfzijl.

Figure 14: Feedback at the townhall meetings in Delfzijl. Source: Eemskrant.nl, Municipality of Delfzijl.

TOWARDS A 'SILENT' GREEN DEAL FOR EEMSDELTA

The unprecedented challenges that faces Delfzijl provide unexpected and unavoidable opportunities to build back a better and more resilient municipality with energy efficient and climate adaptive residential areas. One of the core conditions for the redevelopment is that all new residential areas will become energy neutral, have solar panels, and are resistant to new earthquakes. In the less dense portions of the municipality, all upcoming interventions and redevelopments accelerate the need to upgrade outdated infrastructure and to improve crucial and safe networks for cycling, water storage, landscape and ecology that will make a better and more attractive city. The Opening Statement of the local Strategy on Spatial and Environmental Planning refers to the five core values of Eemsdelta.

- **Attractive**: Eemsdelta becomes an attractive area for current and future residents, companies, recreationists and tourists, focusing on the heritage of its canals, water system, landscapes and settlements, and shaping liveable places in the aftermath of the earthquakes;
- **Reliable**: Eemsdelta provides insight into future developments in the municipality, thereby creating a reliable and clear picture for the inhabitants safeguarding the urban resilience, ecological capacity and climate change adaptation;
- **Connected**: Eemsdelta becomes an accessible area for its citizens, visitors, businesses and cargo, enhancing rural and urban connectivity by sea, water, road, rail, and the internet to create a vital environment for economic development;
- **Innovative**: Eemsdelta ensures its economic diversity and resilience to utilize its strategic positions in the Groningen Regional Energy Strategy and in the bio-based and circular economy;
- **Community**: Eemsdelta improves the quality of life and creates a healthy and an inclusive urban environment for and with its residents, social organizations and local businesses.

These core values form the compass or dashboard of the 'silent' Green Deal for Eemsdelta. Silent, as this is not widely communicated as a 'green deal'. For Eemsdelta, as building back a better Delfzijl will take five of more years and will be part of the policies and operations of the merged and newly formed municipality in 2021 and beyond. The process to rapidly transform the port city Delfzijl, and subsequently Eemsdelta, into a more sustainable, attractive and liveable city and a more resilient and equitable society is inevitable dynamic and will evoke many challenges and opportunities. It requires both a grand and bolt vision on values, spatial development and placemaking, as well as a permanent attitude of reflection and evaluation.

Postscript

In the five months (May-September 2020) since the completion of this article on Rebuilding Delfzijl, the Groningen Region was hit by 36 earthquakes induced by the extraction of natural gas[26]. Four of these earthquakes had a magnitude of 2.0 or more[27] and two of these were followed by a smaller aftershock. On 11 September 2020, minister Kajsa Ollongren of the Ministry of the Interior and Kingdom Relations, announced that on top of the 527 houses as mentioned in this article another 337 houses will be demolished and rebuild in Delfzijl. This brings the total of the residential redevelopment and urban renewal assignment in Delfzijl for the next five years on 864 houses for 2.000 inhabitants[28].

Endnotes

1 https://dwarshuis.com/earthquakes-groningen-gas-field/history-groningen-gas/

2 https://www.nrc.nl/nieuws/2019/06/04/rutte-biedt-groningen-excuses-aan/

3 https://www.nytimes.com/2019/10/24/business/energy-environment/netherlands-gas-earthquakes.html/

4 https://www.waddensea-worldheritage.org/

5 https://www.chemport.eu/discover-chemport/ecosystem/production-cluster-delfzijl/

6 https://www.groningen-seaports.com/en/ports/delfzijl/

7 The main canal connecting the port of Delfzijl with industrial cities in the north.

8 https://www.rtvnoord.nl/nieuws/217395/Beukema-Delfzijl-zal-de-komende-jaren-veranderen-in-een-grote-bouwput

9 A big difference with earthquakes elsewhere in the world is the depth where the Groningen earthquakes occur. An earthquake with a magnitude of 6.0 several kilometers below the surface in Turkey or Iran can cause the same peak ground acceleration as an earthquake of 3.6 several hundred of meters below the surface in Groningen. https://dwarshuis.com/earthquakes-groningen-gas-field/richter/#/s0/

10 According to a lawsuit being pursued by 3,500 victims, an estimated 100,000 houses in Groningen have lost an estimated € 1 billion Euro in value due to seismic activity.

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15 https://www.klimaatakkoord.nl/documenten/publicaties/2019/06/28 national-climate-agreement-the-netherlands

16 In 2017, Spatial Planning and the preparations for the new Environmental Planning Act were transferred from the Ministry of Infrastructure and the Environment (2010-2017), the successor of the Ministry of Housing, Spatial Planning, and the Environment (1982-2010), to the Ministry of the Interior and Kingdom Relations.

17 https://www.government.nl/topics/spatial-planning-and-infrastructure/revision-of-environment-planning-laws/

18 https://www.rijksoverheid.nl/documenten/rapporten/2019/08/01/draft-national-strategy-on-spatial-planning-and-the-environment-engels/

19 https://www.regionale-energiestrategie.nl/

20 Around 1,500 houses in Loppersum, 1,200 houses in Appingedam and 600 houses in Delfzijl. In future neighboring municipalities of Eemsdelta (Groningen and Midden-Groningen) another 2,000 houses will be demolished and rebuilt.

21 https://www.rtvnoord.nl/nieuws/217395/Beukema-Delfzijl-zal-de-komende-jaren-veranderen-in-een-grote-bouwput/

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23 Actieplan Centrum Delfzijl, 2012-2022, Gemeente Delfzijl. https://www.delfzijl.nl/waterfront-delfzijl-marconi. https://www.delfzijl.nl/over-de-gemeente/projecten-centrum-delfzijl_44273/

24 https://www.eemskrant.nl/gemeente-delfzijl-maakt-nieuwbouwlocaties-bekend-voor-honderden-nieuwe-woningen/

25 https://www.thuisindelfzijl.nl/

26 http://cdn.knmi.nl/knmi/map/page/seismologie/all_induced.pdf

27 2020-05-02 Zijldijk: Magnitude 2.5; 2020-07-14 Loppersum: Magnitude 2.7; 2020-07-19 Startenhuizen: Magnitude 2.3; 2020-05-02 Westeremden: Magnitude 2.0.

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A Survey of Urban Planning and Architecture in Iran: Post-Oil Urban Planning Suggestions

Nasim Iranmanesh

Figure 1: the building of senate (photo by author)

Figure 2: Golestan palace in Tehran (photo by author)

Iran is a vast country with an ancient civilization. During its history this country has been changed a lot by wars, other forms of natural and man-made destruction. We take great pride in our cities and rich history of urban planning and traditional architecture.

During the Qajar dynasty (1789 -1925) Iran wasn't an industrialized and developed country. Actually, most of the population suffered from lack of finance and low economy. In spite of this fact, Iran had a splendid architecture in distinct buildings such as mosques, palaces, shrines, gardens and so on. Iranian architects designed and supervised the construction of rich and fabulous buildings in many parts of Iran.

With regard to urban planning. most cities had an organic urban fabric but there were noticeable urban spaces mostly were allocated to religious and civic activities.

The following are some pictures from buildings of Qajar era and cityscape of a typical city of that time. The following images depict cityscape and architecture of Iran in Qajar dynasty (1789 – 1925).

Toop-Khane square is one of the oldest and most historically imporatant squares in Tehran city. Many changes have been happened in its form. For example, the facade of this square was completely changed twice.

Figure 6 and 7 belong to the toop Khaneh square in Qajar era. Nowadays and the facades of this square has been changed completely.

Another feature which changed is "Lale Zar" street in Tehran. Originally it was a garden belonging to the King of Iran "Naser-e-din" shah. Later it was redeveloped into a boulevard, similar in design to the Champs Elysees in Paris, so the The king of Tehran drive along it.

Education and science in Iran were in a traditional manner and there were just few physicians from Europe specially from France (Figure 9 and 10).

Despite the fact that both Nasere-din Shah, the king of Qajar and his son Mozafar-din Shah the next king of Qajar were very interested to visit Europe to have a good time, they were not interested in learning about modern industry or science. But they did bring some patterns from European architecture to Iran which were implemented by Iranian architects in building some palaces (Figure 8).

IRAN AND OIL INCOME IN MODERNIZATION AGE OF IRAN AND ITS ARCHITECTURE AND URBAN PLANNING (1923-1979):

Oil surveying was first authorized in 1901 subsequent to an Englishman, John D'Arcy, signing the "D'Arcy Concession" with the King of Iran. As a result, in 1908 a large amount of oil was discovered in southern Iran near Masjed Soleymanye city. A British oil company, the Anglo-Persian Oil Company, was formed in London but in 1914 the British Government became a majority holder of this company to ensure a steady supply of oil as its Navy converted from coal steam engines to oil steam turbines. Ultimately in a deal to expire in 1993, all Iranian oil was to be sold to the British at a fixed price and Iran was forbidden to export oil to any other company or nation.

Finally, oil was nationalized in 1950 by act of the Majlis, the Iranian Parliament and in 1951 Dr. Mosaddegh, Prime Minister of Iran, created the National Iranian Oil Company (NIOC). However, the British and American Governments organized a government takeover in 1953 which re-establishment the Pahlavy dynasty. The new government initiated of a deal where oil profits were shared between NIOC and a consortium of international companies.

Reza Shah the first King of Pahlavy dynasty (1923-1941) was enthusiastic to develop Iran and modernize it. Using revenue from the oil agreement many in-

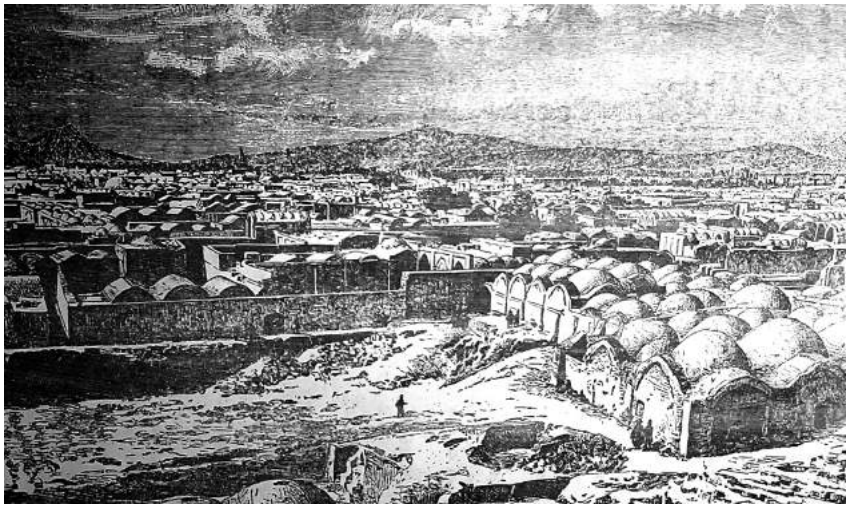

Figure 3: cityscape of a Qajarian city (source:Dieulafoy)

Figure 4: Urban fabric of most of the cities of Iran Qajar dynasty (photo by author)

Figure 5: A cityscape of Tehran in Qajar dynasty 1880s (photo by author)

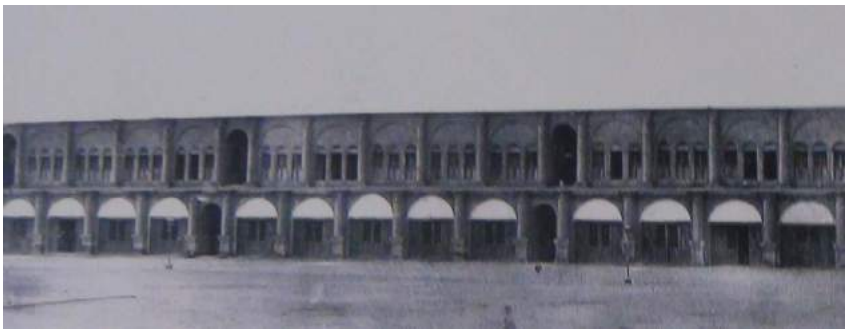

Figure 6: One of the façades of Toopkhane square

Figure 7: Toopkhane square in Tehran(Qajar era) (photo by author from historical pictures)

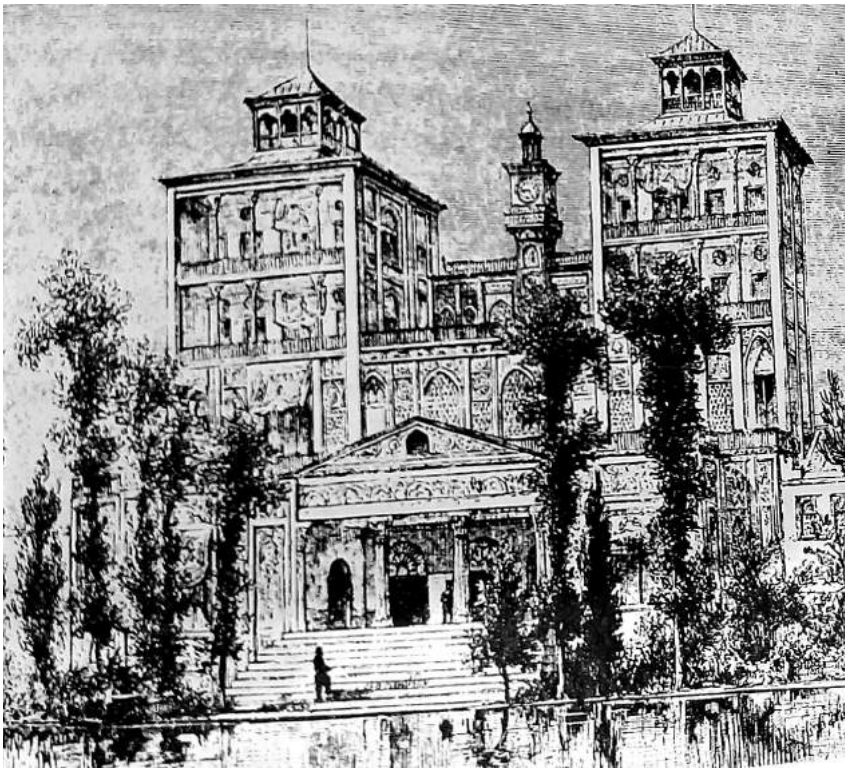

Figure 8- Sham –ol- Emare Palace in Tehran inspired from European buildings (source: Dieulafoy)

Figure 9: Bazar of Iran (Shiraz)
(source: Dieulafoy)

Figure 10: Some pictures from the people of Qajar era
(source: Dieulafoy)

Figure 11: A man in one of the lanes in central region of Tehran in 1960s

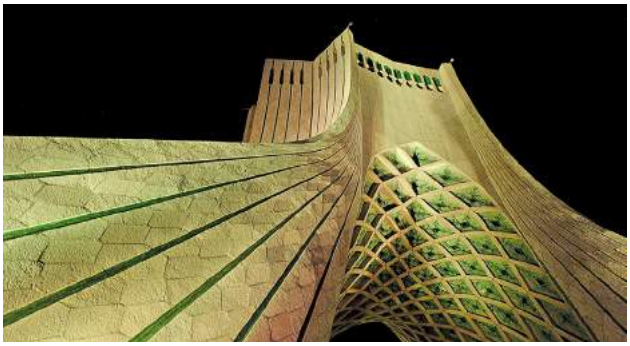

Figure 12: Azady square in Tehran (the monument of Tehran) 1970s

stitutions, such as universities, as well as army and railway buildings were built.

Activities toward modernization increased during the next King of Pahlavy, Mohammad Reza Shah. Various developments such as building many modern buildings like gym, stadiums, museums, great monuments and so on were increased rapidly funded with oil money. In 1970s the price of oil was substantially increased and the government of Iran was suddenly faced with a great economy, which enabled them to be improved many aspects, especially in architecture and urban planning. Tehran the capital of Iran erected many new modern buildings and many new residential areas were built. The population of Tehran increased to more than 5 million.

The government also began to modernize other cities and especially Tehran by planning new residential districts, streets, squares, boulevard and modern buildings such as hospitals, cinemas and theatre, universities, high-rises buildings and so on. Most of them were planed and built by oil money of government and top-town planning was the only way to implement these projects.

The above pictures (Figure 11 and 12) show some urban spaces which were built in 1970s. Also there are two pictures which compare the past situation of some regions of Tehran between 1960s and 2010s. Both regions have a large population and they are two important parts of Tehran which encompass many large commercial and administrative buildings, populated residential buildings and parks.

The below pictures (Figures 13 and 14) belong to the before and after situation of one the famous boulevard of Tehran which is named Keshavarz boulevard this space was converted to a planted boulevard.

Figure 13: Comparing the built environment of intersections of Keshavars boulevard and Kargar street in 1960s and 2010s

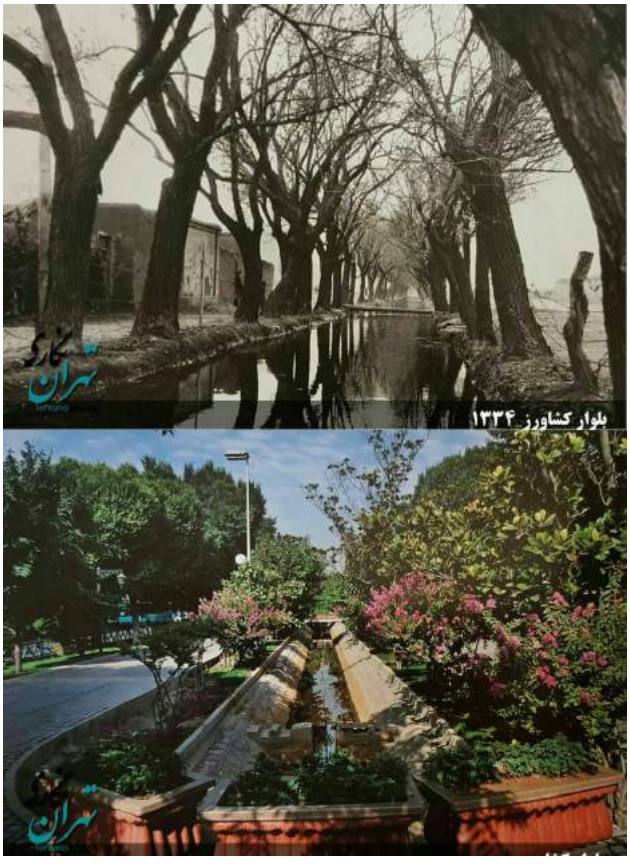

Figure 14: Keshavarz Boulevard before construction in 1960s and in 1970s

URBAN PLANNING AFTER THE ISLAMIC REVOLUTION IN IRAN

The Islamic revolution of Iran occurred in 1978 and the kingdom of Pahlavy was finished. After the revolution there were some new ideas and attitudes but there also was disorder with side effects in many aspects. For example. the relation of Iran with some countries was changed, most notably when Iraq attacked Iran in 1980 and everything became worst. The Iranian economic then focused on war so that some expensive architectural and urban planning projects could not be pursued. Additionally, the war with Iraq lasted for eight years and it caused a lot of physical damage to the country.

After war there was an urgent need to reconstruct the cities which were damaged by war in addition to the need for urban planning and modernization. But following the war, the price of oil decreased sharply so that just few large buildings for some special purposes such as administrative and residential were built. Urban planning had few and limited activities.

In the 1990s construction activities were increased and but many buildings were built without conforming to building codes or city plans. Because of this rapid development the image of cities changed again especially in Tehran. Actually, lack of sufficient rules in urban planning and a great tendency to ignore architecture and urban planning rules caused that many cities to sprawl. A poor economy, lack of proper knowledge for urban planning, lack of proper management to implement the plans and (maybe the most important reason) ignoring the roles of architecture and urban planning are some of reasons for this period of unregulated development. In addition, Iran is vulnerable to earthquake. There are special codes to insure the strengthening of building against earthquake but unfortunately most of these rules also were ignored by builders. So, these weak buildings are a real threat for city and citizens in case of earthquake. Most of this construction was done by the government. Viewed another way, urban planning and development was accomplished top to down as before and people were unable to participate in urban planning projects.

Tehran is a major example of how cities in Iran changed to a populated city, with a heavy traffic jam, with a chaotic cityscape and finally heavy air pollution. The following pictures compare the cityscape of Tehran in the clean day and the same image in a polluted day. Bad urban planning and unthoughtful sprawling of cities caused polluted cities which suffer their citizens in many months of the year (Figure 15).

It should also be said that urban infill development is not considered very much and often urban planners and citizens prefer to move to a new region and make a new district to settle. So, the old regions remained worn out and unqualified for residents and this forces the old residents to move to new region of city and old region while their previous homes are occupied with low income and mostly illegal people like addicted people or similar (Figure 16).

Government efforts to solve this problem by building new residential units in old regions were not successful (Figure 19). The reason of this failure is these top -down residential developments did not appeal to the intended targets. If people be able to participate in urban planning the result will be more proper and adaptable for them.

It can also be said that oil money was always the main finance resource for urban planning projects till now. After restricted sanction against Iran by U.S.A in 2019, oil income of Iran was decreased too much and many projects had to mitigate their activities because of lack of finance resources.

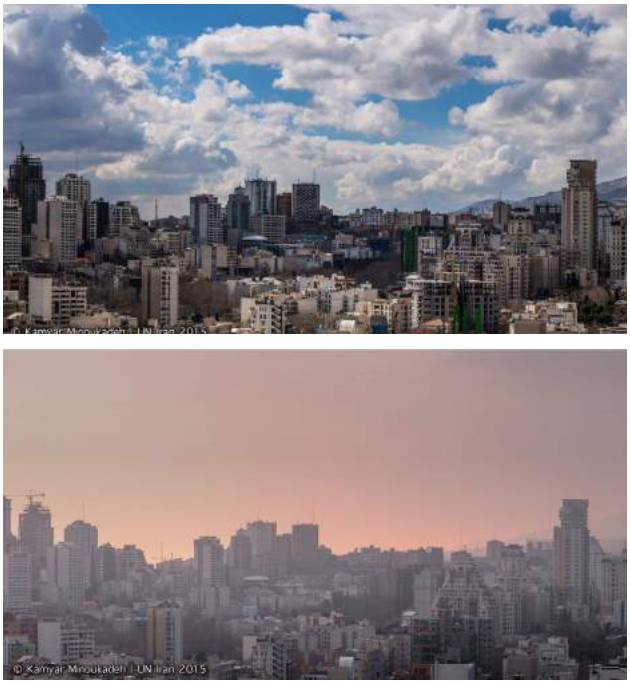

Figure 15: Comparison of the chaotic cityscape of Tehran in a clean day and polluted day

Figure 16: A norrow lane in old region of Tehran (photo by author)

POST OIL PLANNING RECOMMENDATIONS

Severe sanction against buying oil from Iran and its resulting severe economic impacts might be an opportunity to push Iran to gain another finance resource. Iran is a rich country with various potential in mineral resources, harbors, agriculture, tourism, industry and so on. With effective planning each can earn a large income and offset the loss of oil money.

In addition, Iran has a lot of energy of sunshine and wind which can be converted to electric power. So domestic oil use can be replaced by this natural energy powers. Using renewable energy is a great challenge nowadays specially in developed countries. Iran has limited experience with renewable energy, but it can learn from the expertise in other countries. And there is the possibility to improve the technology to prevent from lagging behind more developed countries.

The most important change to Iranian urban planning is changing from a top – down approach to bottom-up planning. Top down urban planning was common because of oil income. This way should be diverted to bottom up urban planning by considering citizens' rights. If citizens work for solutions tasks will be solved and should change the process of urban planning in Iran. Good legislation to enable citizen participations in urban planning project can facilitate bottom-up planning and this can lead urban planning to independency of oil income.

Another item which should be considered in urban planning is pedestrianization. Giving priority to pedestrian in urban planning project will an effective way to mitigate the consuming oil. The best way of expanding pedestrianization is planning pedestrianized neighborhood in cities. Middle size cities with pedestrianize neighborhood will decrease the requirement for oil.

Transit Oriented Development or TOD is another way to mitigate traffic and oil consumption, many countries have taken great steps toward TOD. TOD in Iran has been implemented in some parts especially in Tehran, but there are still many steps toward an efficient public transportation.

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مادام ژان دیالافوا ، ترجمه علی محمد فره وشی (1874) ایران ، کلده ، شوش / انتشارات دانشگاه تهران

Future Cities, Post-Oil Cities:
Underground Spaces as Vital Part of the Urban Metabolism

Han Admiraal, Antonia Cornaro

POST-OIL DEVELOPMENT - CHANGE IS COMING

On 23 September 2019 a young Swedish teenager, Greta Thunberg, spoke to the world as representatives of the UN member nations gathered in New York. "*We will not let you get away with this. Right here, right now is where we draw the line. The world is waking up. And change is coming, whether you like it or not*[1]*".*

Change is coming whether we like it or not, we are collectively transitioning to a new reality- a new geological epoch, the Anthropocene. For the first time in our planet's history, humankind worldwide is interfering in the Earth's natural cycles. '*We do not live in an era of change, but in a change of era*' as Jan Rotmans, professor of transition management at the Erasmus University in Rotterdam, poignantly states[2].

Hajer & Dassen[3] identify two issues in this context. First, they argue that disconnecting our cities from the carbon-based infrastructures requires more than just a new 'smart-city' concept. Disconnecting from our industrial and carbon-based past requires cities of the future to address:

1. decoupling from fossil resources,
2. adaptability in terms of how to absorb the shocks and stresses cities face, and
3. circularity as humankind moves towards a new paradigm in which we don't exploit the Earth's resources to their limits, but rather try to strike a balance between the ecological ceiling and the social foundation[4].

Secondly, Hajer & Dassen argue that the tragedy of our time lies in the way that new cities are planned and created much along the lines of 20th century pioneering cities in the Western world. This replicating behaviour has created cities that look and feel like any other city but that can be terribly misplaced given the specific local context in which they exist. It is this local context in which the urban being and its metabolism exist. The consequences of the current approach to cities can be severe; "*Without business and policy model changes, resource use will more than double from current levels to 190 billion tonnes by 2060 and far exceed our planetary boundaries. Disconnecting human progress from a dependence on natural resource use will be key.*" [5]

Post-oil development, especially in the Gulf region, will require rethinking the continued construction of Western styled high-rise buildings. Gulf buildings and cities need to be adapted to the temperature extremes of the Gulf region[6]. The urban environment needs to adapt to the future that lies in store.

In this light, we feel the subsurface comes into play. In the urban metabolism discourse, it is impossible to exclude the subsurface. When it comes to developing post-oil cities, the subsurface holds the potential to become an asset.

TO EACH CITY ITS OWN STORY

Throgmorton[7] makes the case for planning to consist of a story, a well-developed narrative, that involves multiple actors. For him planning consists of a process of constructing persuasive stories about the future of cities, where meaning depends on context. Meaning depends on context is a rationale that we will further explore. In our opinion it is a much-overlooked aspect when developing cities. For example, Hall[8] quotes Oscar Newman on the failure of the Pruitt-Igoe urban housing project in St Louis, Missouri, USA: "*the architect was concerned with each building as a complete, separate, and formal entity, exclusive of any consideration of the functional use of grounds or the relationship of a building to the ground area it might share with other buildings. It is almost as if the architect assumed the role of sculptor and saw the grounds of the project as nothing more than a surface on which he was endeavouring to arrange a whole series of vertical elements into a compositionally pleasing whole.*" This stark criti-

cism not only defines the importance of context but also the fixation with the surface as base plane for urban development.

An interesting example of meaning are the stations of the Moscow Metro. We illustrate the stark contrast between designs of early metro stations in our book (Admiraal & Cornaro[9]) by citing Kettering[10] a speech held at the opening of the first line of the Moscow metro in 1935: *"The subway in capitalist nations, he announced to a cheering crowd, was intended to generate the highest possible profit and its interior was therefore monotonous, dirty, dim, and altogether 'crypt-like'. Such a gloomy atmosphere, he maintained, could in no way offer the worker repose after a long day, but would instead further exhaust the pitiable proletarian in London or New York. Conversely, in a socialist society, with its greater consideration for its workers, the government would naturally choose to build more splendid and therefore expensive structures that would assure the population not only convenience but 'palatial' architecture creating feelings of joy and happiness, or 'zhizneradostnost'."* We cannot escape from the idea that a certain amount of propaganda was part of this message, however it illustrates the idea that giving meaning to design can be interpreted differently. Even today, there is a stark contrast to the art-based stations of the Stockholm metro and the stark uniform design of the latest stations of London Underground's Elizabeth Line.

Meaning depends on context becomes even stronger when looking at the unique earth shelters of China known as Yaodong. The earliest Yaodongs date back to the Qin Dynasty (c. 221 BC)[11] and they are predominantly found in northern central China, in an area consisting of six provinces that cover 400 000 km^2. The region boasts a population of over 40 million. Outside urban areas, 80% of the population live in Yaodongs, amounting to millions of people still using this form of underground habitat. Liu et al[12] saw the movement to retain the Yaodong as an important example of regional architecture. They argued that from the point of view of critical regionalism, it is essential to merge the essence of the old with the new "*in contrast to the rampant and largely unreflective importation of Western architectural styles common to new construction in many of China's urban centres*".[13] In essence, the Yaodong, bequeathed by previous generations, represents a critical regional architectural form that has survived the test of time and can be easily adapted to the modern way of life to become a contemporary form of housing.

We can expand on the idea of 'meaning depends on context' through 'critical regionalism'. The latter is discussed by Moosavi et al. where they state "*In the arid lands of the Middle East, the struggle against aridity over centuries has fundamentally shaped cultural and technical methods of interaction with the landscape, resulting in many vernacular practices. The formation of old settlements in the region was highly interlocked with the ecological structure of the land. With the advent of Modernism, many vernacular practices gradually faded away, largely due to urbanisation and rising modernisation of methods and techniques. Rapid urbanisation in the last two decades has modified and changed the integration of culture and the physical landscape and has led to destruction of long-established ecological-cultural systems.*"[14] Critical regionalism is in direct contradiction with the Western replication practice that modernism has brought to the Gulf states. It also makes us question the role of critical regionalism in post-oil development.

Moving toward a new paradigm for post-oil cities planning requires addressing urban adaptability. It requires projects that point "(...) *the way forward in the Middle East and acts as modern exemplar of a 'situated' design, with its re-orientation of pre-existing, vernacular design approaches to water and aridity. It uses experimentation, local knowledge and global aspirations for ecologically grounded work, with cultural context paramount.*"[14]

Figure 1: Yaodong pit dwellings on the Loess Plateau, located around the Wei River valley in the provinces of Shaanxi and Shanxi, China. [Image courtesy of Imagine China REX/ Shutterstock]

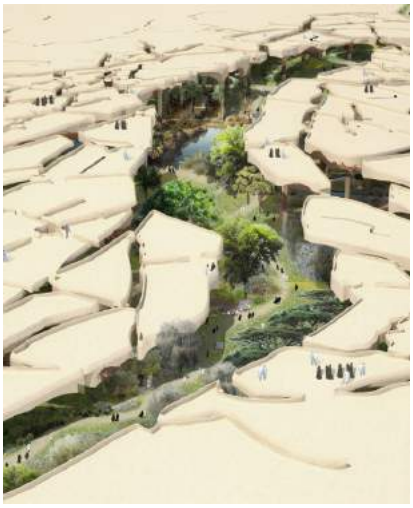
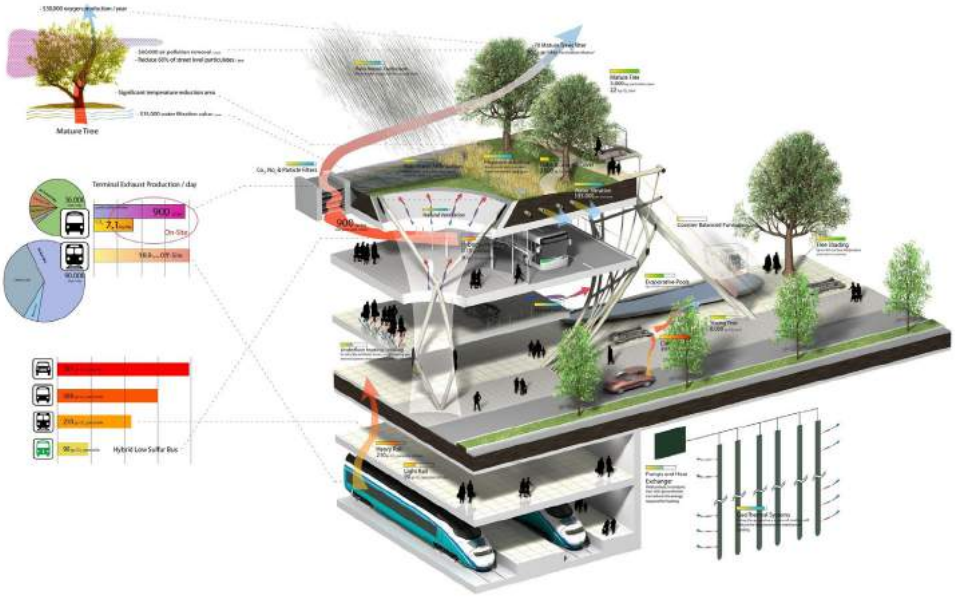


Figure 2: Al Fayah Park, Abu Dhabi, UAE. [Image courtesy of Heatherwick Studios]

Figure 3: A pedestrian arcade in Turin, Italy. [Image courtesy of Takeaway reproduced under CC BY-SA 4.0]

Figure 4: Air-conditioned Bus shelter in Dubai, UAE. [Image courtesy of ID 39815498 © Sergii Figurnyi | Dreamstime.com]



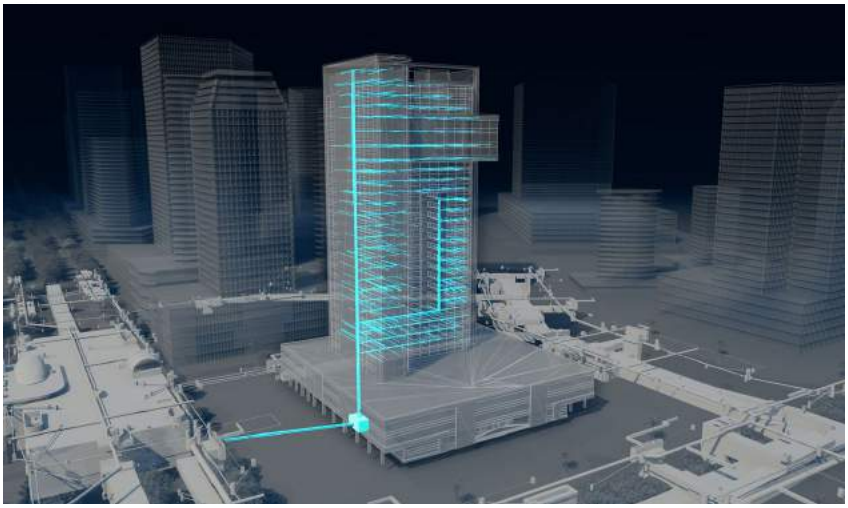


Figure 5: Transbay Transport Centre sustainability design, proposed District Cooling Lusai City, Qatar, and a termite mound. [Except Integrated Sustainability reproduced under CC BY-SA 2.0; Copyright 2015, Lusail Real Estate Development Company W.L.L, and Image courtesy of Thamizhpparithi Maari reproduced under CC BY-SA 3.0]

Figure 6: Ewha Womans University, Seoul, South Korea.
[Image copyright André Morin/Dominique Perrault Architects]

SURVIVING THE 50°C CITY

When looking at post-oil cities in the Gulf region, it becomes pertinent to question how people will live and survive in a 50°C plus environment.

Going below the surface and exploring underground space is a valid option to finding a lower temperature environment. We need to move from landscaping to groundscaping as proposed by French architect Dominique Perrault[15]. The importance of his work lies in the fact that he shows that manipulating the surface-subsurface interface, new spaces can be created that integrate into the surrounding landscape. This is perfectly demonstrated (illustrated in Figure 15-17) with the Ewha Womans University in Seoul, South Korea, where Perrault has created not only underground spaces, but a void which serves as both a public space, an entrance portal, and a daylight resource for the spaces below the surface. It is through combining surface and subsurface that his intervention creates a new transformative groundscape that gives new meaning to the surrounding context.

In the Gulf region, we see an emerging use of the subsurface. It is however limited to public transport systems and utilities. What is needed is to take the concept of groundscapes and combine that with critical regionalism to create a post-oil urbanism that embraces the subsurface. Cities need to be liveable and walkable for people to meet in public spaces. By creating a new urban tissue below the surface, connecting buildings through public spaces using urban corridors, a new type of radical underground space use can be created that enhances the city and allows it to thrive under extreme climate conditions.

Moreover, in doing so, cities are created that could in effect be the precursor to the type of habitats humankind may need to consider in the future. Already architects and entrepreneurs alike are exploring ways to survive in underground lava caves and tubes on the Moon. Research is emerging into food production using lava substrates. For a region that has to cope with extreme climate conditions, there are many opportunities to embrace these ideas and use them to survive the 50°C city. In doing so, new meaning could be given to cities recognising the specificities of the region and shift towards post-oil urbanism which is radically different from the West.

POSSIBLE APPLICATIONS OF RESOURCEFUL SUBSURFACE PROJECTS

Alraouf[16] describes the post-oil paradigm in urban planning that leads to Dohaization as being based on the value of a knowledge economy and a knowledge-based urbanity. Doha has evolved from a fishing and pearling village to an expanding world city, where "*ambition and means are fueling exciting experiments in education, health, sports and culture*"[17]. Alraouf specifies walkability and liveability as two principal values that are being introduced into the urban practice of Doha. However, it is uncertain whether these values will lead to a replication of the West or if new insights will emerge from critical regionalism.

Using the subsurface for shelter- against heat, storage of water, food production, energy reduction, production and storage, and protection against natural and man-made disasters- is a concept that not only deserves further investigation but should become a vital part of the urban planners' toolkit in the post-oil era.

Post-oil development can be based on two ideas: One, use critical regionalism to adapt the urban being to the context of the region and climate change; second, embrace the region's role as energy supplier by moving away from fossil fuels to create synthetic fuels and feedstocks based on CCUS (Carbon Capture, Utilisation and Storage). In the following section, a few examples of these ideas implemented elsewhere are discussed.

Figure 7: Schematic Illustration of Hybrid Na-CO2 System and its Reaction Mechanism. [Image courtesy of Kim et al. reproduced under CC BY-NC ND 4.0]

Public transportation

Public transport is seen as an integral part of transit-oriented development. In Dubai, the introduction of public transport has led to the adoption of Western-style fully air-conditioned bus stops that allow passengers to wait in comfort rather than in debilitating daytime temperatures.

Food Security

When it comes to food, the Gulf region is as dependent on other countries as countries are on the Gulf for fossil fuels. The UAE imports 60% of its food supply as local food production is constrained by the availability of water. Already 70% of the country's water supply is used for agriculture. At the same time, the groundwater tables are dropping, and salinity is becoming an issue as seawater infiltrates[18] as a result of lowering groundwater tables and rising sea levels. Food and water security are as much an issue to survive as combatting the increasing heat. Any post-oil development needs to address both these issues with urgency.

However, as Cabannes & Marocchino[19] observe: "*The prevailing sectoral planning and decision-making approach, and its lack of a holistic perspective, seems another reason explaining why 'food has been a stranger' to urban planning.*" They argue that a 'holistic' approach is needed to food systems in urban areas. Food systems are defined as: "*the entire range of activities involved in the production, processing, marketing, consumption and disposal of goods that originate from agriculture, forestry or fisheries, including the inputs needed and the outputs generated at each of these steps.*"[20]

In Switzerland, the Swiss Centre for Applied Underground Technologies (SCAUT) has been working on the concept of underground green farming. SCAUT sees potential for industrial-scale vertical farming concepts in underground spaces, either existing or purpose-built. One of the major advantages is that the subsurface offers stable climatic conditions enabling low energy growth stimulation of plants and crops. Vertical farming uses various methods to ensure the circularity of the systems while at the same time dramatically reduces the water consumption to as little as 10% of the water consumed in traditional agriculture[21].

Figure 8: Underground Green Farming at the Hagerbach Test Facility, Flums, Swizerland. [Image courtesy of SCAUT]

Energy Conservation

One of the side effects of the Western replication is that more and more energy will be required to cool structures and provide conditions for people to use in the city. An example is Lusail City in Qatar that will feature an underground district cooling system. It claims that the system reduces energy consumption and acknowledges current technologies as the way forward. This seems a far cry from biomimicry where solutions for contemporary and future challenges are sought from nature. Termite mounds are a perfect example of an internal cooling system using convection air currents through both vertical shafts and horizontal openings. This concept has been expanded on in the sustainability design of the Transbay Transport Centre in Los Angeles, CA, USA and the Eastgate Centre in Harare, Zimbabwe.

Using the subsurface and its underground spaces may well become the next leap forward for the region, creating a post-oil urbanism that helps humankind survive on this planet and at the same time pave the way for post-earth settlements of the next century.

Gulf States could lead the way in making cities smarter, a process that may yet prove to become a necessity as environmental conditions may force them in this direction. How many tourists want to go somewhere they'll be scorched at the surface? A lot more tourists may want to venture to an urban oasis that sprawls and connects below the surface in the same way future colonies might take shape on other planets.

At the same time, these hidden spaces can become part of the quest for renewable energy as the 'Minewater' project in Heerlen, the Netherlands demonstrates. Thermal aquifer storage systems are rapidly becoming a primary source for heating and cooling houses. SCAUT is also testing how underground data centres can be placed below the surface to reduce energy costs and reusing the heat they produce for other purposes.

For the past 70 years, we as humans have been depleting the Earth's natural resources by tapping into those underground spaces that provide fossil fuels. At the same time, we are facing a worldwide crisis through the emission of CO_2. Carbon capture and storage (CCS) using electrolysis, as opposed to letting the molecules float away, is seen as one of the options to improve air quality.

Could post-oil development embrace carbon capture, utilisation, and sequestration (CCUS) by repurposing empty gas fields and create hydrogen as a new energy carrier? At an industrial scale, this could provide the Gulf region with energy and even produce hydrogen for export to other parts of the world. The process requires CO_2, water and energy (Kim et al.[22]). Renewable energy in

terms of solar energy is plentiful in this region. Why not use that to capture and convert CO_2 and at the same time create an energy carrier that can be stored until needed and is clean in comparison with contemporary fossil-based fuels.

Mitigate heat Islands

We already know the urban heat island effect is caused by vast areas of concrete and pavement. Replicating Western planning practice and focus on cars and highways adds to the rising temperatures.

A model might be the Al Fayah underground park in Abu Dhabi. The project aims at replacing an existing European style park by creating a park below grade. The design, by Heatherwick studios, is conceptually based on the cracked surface of dried soil. Using this theme, a cover was designed for the park providing shade while also allowing airflow. The elevated plates that provide covering, can serve as a network of social and meeting places in cooler evening hours.[23] (Heatherwick, 2010).

SUB TERRA NULLIUS

Using the subsurface requires us to fully understand and comprehend what this implies. Melo Zurita[24] observes that the subsurface has mostly been approached as being a sub terra nullius. In doing so, it shows remarkable similarities with how explorers from the West found and claimed territory in the rest of the world, a world they perceived as Terra Nullius. This means 'nobody's land'. With hindsight, we are still discovering what these claims brought about and how the original inhabitants were literally not acknowledged. While they live on the land, it doesn't give them the right to the land' seemed to be the way the self-proclaimed superior explorers approached them. These explorers were oblivious to reality and only saw the advantages the land offered them.

Exploitation of the subsurface shows a remarkable resemblance. Humankind has been digging away at the subsurface to discover the hidden resources that it contains. With the advent of technology during the Industrial Revolution, the demand for more resources led to a rapid exploration and exploitation, depleting the Earth of its natural resources and at the same time causing the challenges we now face. As we show, towns and cities are not only confronted with the effects of climate change due to excess carbon emissions, human-induced earthquakes are traumatising the northern part of the Netherlands caused by decades of gas extraction. Former mines cause sinkholes through the collapse of ancient galleries, long forgotten[25].

The question is: does access to technology give us the right to exploit the subsurface in whatever way we see fit? Through a lack of vision and planning, the haphazard and autonomous development of the subsurface implies that some cities are confronted with a density of uses and limited space for additional development.

If we are to use the subsurface for post-oil development, we need to identify the right approach. Even though it can play an important role in post-oil cities, we need to approach it with caution. There are fundamental questions that we need to ask ourselves in an attempt to plan the use of underground space.

Melo Zurita proposes we rethink urban undergrounds through the application of four stratums:

1. the more-than-human subterranean,
2. volumetric dispossession,
3. owning the underground, and
4. subterranean access.

These stratums lead to four fundamental questions that need to be asked and that are starting points for planning urban underground space:

1 what already exists underground?
2 who will get dispossessed and affected by the development?
3 who should own the underground and how?
4 who will have access to the urban underground?

This calls for a new planning approach to the subsurface. We argue that a multi-dimensional approach is needed[26], where the subsurface is perceived as a volume rather than an area. Apart from the volume, geology and temporality needs to be considered. Given that whatever is created below the surface will remain there, time as a dimension needs to be addressed. Rather than following the contemporary practice of creating functional purpose-driven spaces, we need to consider creating multi-functional spaces that can have a variety of uses over time.

It does not diminish the ideas we have discussed for using the subsurface as part of the post-oil cities. More than ever it underlines the necessity for the subterranean to be considered as part of the urban metabolism. The urban being and the urban metabolism are complex and dynamic. Making them inclusive with the subterranean does not increase the complexity, rather it helps complete them. To do this we must 'de-alienate' underground urban space. Urban planning is key to this but will need methodologies based on a multidimensional approach buttressed with public participation and across professional disciplines.

For post-oil development, it means that smart cities will become smart by incorporating the subterranean into the urban fabric. As we have shown, the subsurface can be resourceful in more ways than just as a utility or infrastructure layer. We need to avoid the subsurface becoming an urban service layer. It is through the ideas of Perrault and Heatherwick that groundscaping can open up the surface and integrate a multitude of underground spaces to the urban fabric. As such, the subsurface may well prove to be that what is has always been, the foundation for life on this planet.

CONCLUDING REMARKS

To sum it up, we observe that the subsurface is not used as intensively and wisely as it could be. The development of cities in the Gulf region shows that if used, at most it is as an urban service layer. New cities by definition offer the opportunity to develop underground spaces from scratch. However, it remains underutilized through a lack of vision and appreciation of the opportunities it offers.

Smart cities, sustainable cities, post-oil cities could lead the way and be centres for urban research and development. More than ever, post-oil development will need to deal with issues of extreme temperatures, and with food and water security. The subsurface may well offer solutions that have hitherto not been considered. Food production, storage of energy and alternative production of energy are areas that need to be explored and included in future planning processes.

Given the necessity and the need to show climate adaptability, demonstrating this could go hand-in-hand with creating and maintaining the liveability of those cities. As such they could become exemplary for other cities and at the same time lead the way towards new paradigms for post-earth development.

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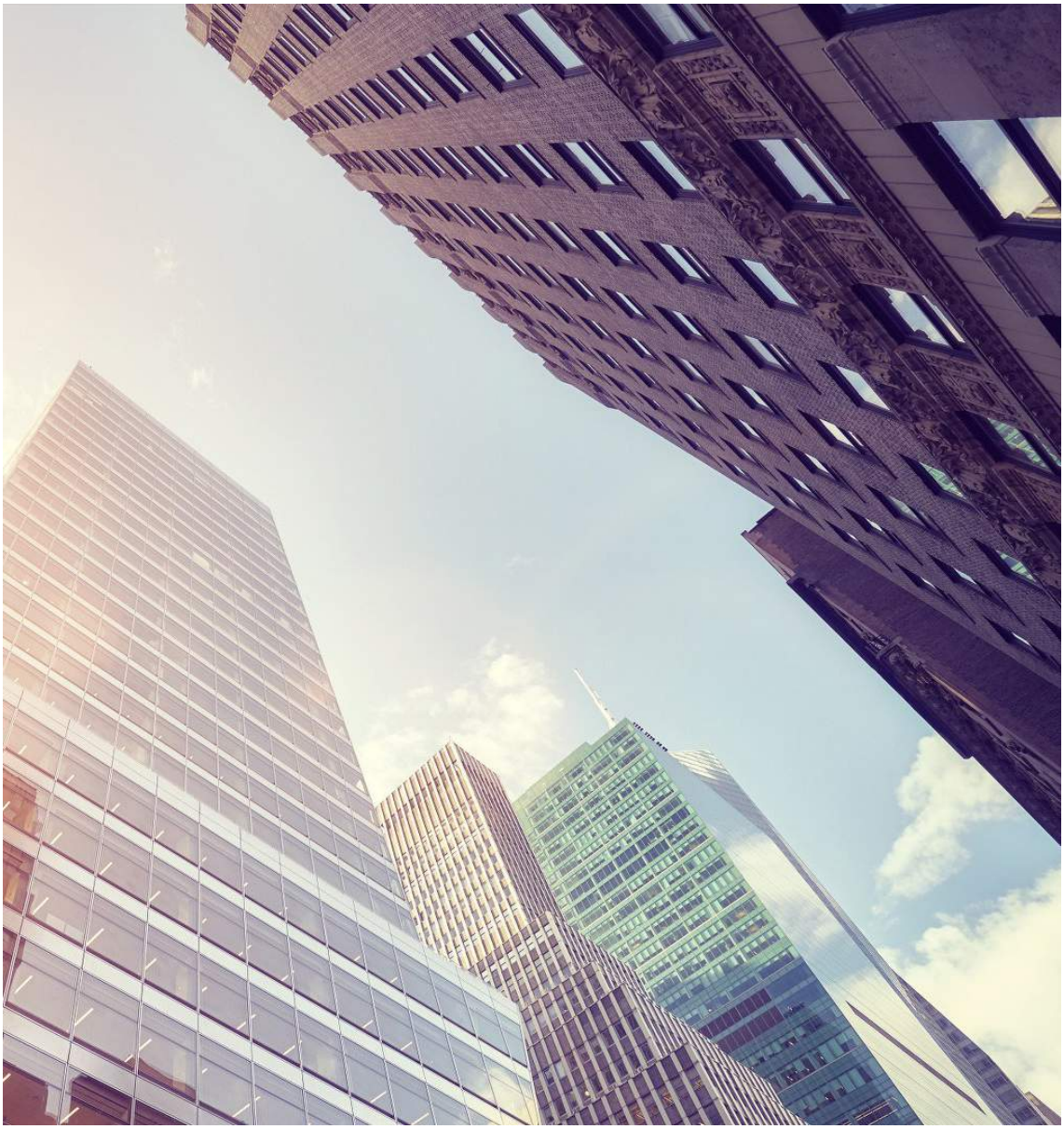
DEVELOPMENT POLICY, RESEARCH AND THEORY

Shaping Livable Places:
New Findings on Extreme Heat, Planning Policy, and Real Estate

Katharine Burgess, Elizabeth Foster



January 2020 was the warmest January in 141 years of global weather recording, according to the United States' National Oceanic and Atmospheric Administration (NOAA). NOAA concluded "meteorological winter hardly made an appearance in large parts of the Northern Hemisphere, as both Europe and Asia recorded their warmest winters ever."

Climate change is not the only cause of extreme heat—and in cities, not even the main cause of more intense, frequent, and long-lasting extreme heat events. With the projected impacts of climate change and continued urban development, many communities are likely to experience higher-temperature days; longer, more frequent heat waves; and intensified impacts in cities where "urban heat islands" (UHIs) form because of the heat-absorbing properties of urban surfaces.

Extreme heat is changing the way people experience living in cities and is beginning to change the design choices of leading real estate professionals and the priorities of forward-thinking land use policymakers. This focus on extreme heat as a primary hazard and design consideration (rather than as a secondary factor for energy efficiency and greenhouse gas emissions reduction) is a key trend described in *Scorched: Extreme Heat and Real Estate*, a 2019 report from the Urban Land Institute.

Based on interviews with more than 50 planners, real estate developers, designers, land use policymakers, and climate scientists, *Scorched* outlines how extreme heat will affect the real estate and land use sectors and highlights the leadership and the potential positive impact of the real estate sector in implementing "heat-resilient" building designs and land uses. The report focuses on the United States, where extreme heat is the most widespread and deadly weather-related hazard. However, many of the mitigation and adaptation strategies detailed in *Scorched,* and summarized here, are applicable to global markets.

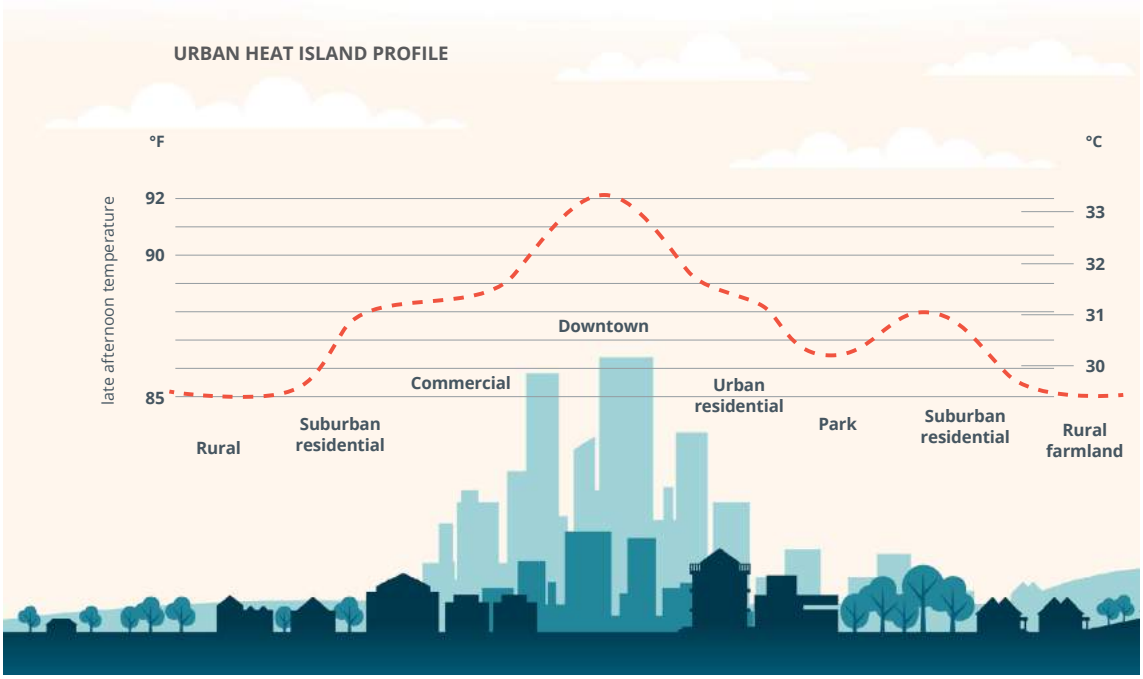


Figure 1: The average air temperature of a city with 1 million or more people can be 1.8° F to 5.4°F warmer on average and as much as 22°F hotter at night than surrounding areas because of the urban heat island effect. [Image credits: Heat Island Group, Lawrence Berkeley National Laboratory, 2019]

There is significant opportunity for the public and private real estate and land use sectors to mitigate and adapt to extreme heat to make cities more resilient and livable today and in the future. Many cities are incorporating extreme heat mitigation and adaptation best practices into resilience and climate action plans. Some cities are also expanding existing green infrastructure programs, forming cross-disciplinary heat working groups, and leveraging zoning, building requirements, and incentives through the development process to encourage thermally comfortable indoor spaces and to minimize the contribution of buildings to the urban heat island effect. The experience of planners indicates that heat will continue to be a growing area of focus for clients and policymakers as a key aspect of ensuring the health, safety and welfare of communities.

Similarly, the experiences of practitioners who have implemented extreme heat resilience strategies suggest that taking action helps to "future-proof" real estate in vulnerable markets; lower operations and management costs; improve tenant and occupant experience; and otherwise differentiate a real estate project. Developments can prevent the absorption of heat with light-colored surfaces and materials, provide direct cooling with increased shade from built and natural shade canopies, and better cope with extremes through "heat-aware" building envelopes and heating, ventilation, and air conditioning (HVAC) choices that stabilize indoor temperatures even during power outages.

EXTREME HEAT IN CITIES: UNDERSTANDING THE SCIENCE

Cities are at elevated risk from extreme temperatures because they absorb more of the sun's energy (i.e., heat) and can be up to 22°F hotter in comparison to their surroundings. This difference in temperature between urban areas and their rural surroundings is called an urban heat island or the urban heat island effect (UHIE). UHIs cause the majority of the temperature rise in U.S. cities; they are 2° to 6°F warmer on average than their surroundings, and cities are warming up to 50 percent faster than non-urban areas.

UHIs are the result of four factors related to building and urban design: land use change (the removal of trees and green space and the addition of heat-absorbing materials), waste heat (mainly from energy use in buildings and transportation), air pollution (UHIs create ideal conditions for smog formation and smog acts as a heat-trapping barrier), and building geometry (the pattern in which its streets and buildings are arranged as well as the size and shape of a city are influential determinants of UHI intensity).

Many building types can both contribute to and mitigate the urban heat island effect. For example, tall buildings create shade (cooling effect) but also trap heat between them and slow or block wind speeds (heating effect). Urban heat islands are not all created equal; an urban area's density, layout, and building types influence local extreme heat dynamics, as do local climate, geographic features, and the surrounding natural environment.

THE BUSINESS CASE FOR ADDRESSING EXTREME HEAT

Without intervention, the current and projected impacts of extremely high temperatures—on people, on the economy, and on infrastructure—are substantial.

In cities, public officials often cite heat waves triggering periods of high mortality, an increasing number of high-heat days, and better data quantifying these local climate changes as motivation for policy action. Public officials also cite Moody's consideration of climate preparedness in bond ratings as a reason for mitigation and adaptation programs and projects.

Research estimating the effects of implementing multiple heat island miti-

Figure 2: Cool Neighborhoods NYC is a specific strategy developed by the Mayor's Office of Resiliency to provide and target additional funding and to coordinate multiple extreme heat mitigation and adaptation projects. Cool Neighborhoods NYC employs local job seekers to install cool roofs, so the program provides residents with employment and job training as well as helps decrease indoor air temperatures and the need for air conditioning [Image credits: NYC Mayor's Office of Resiliency]

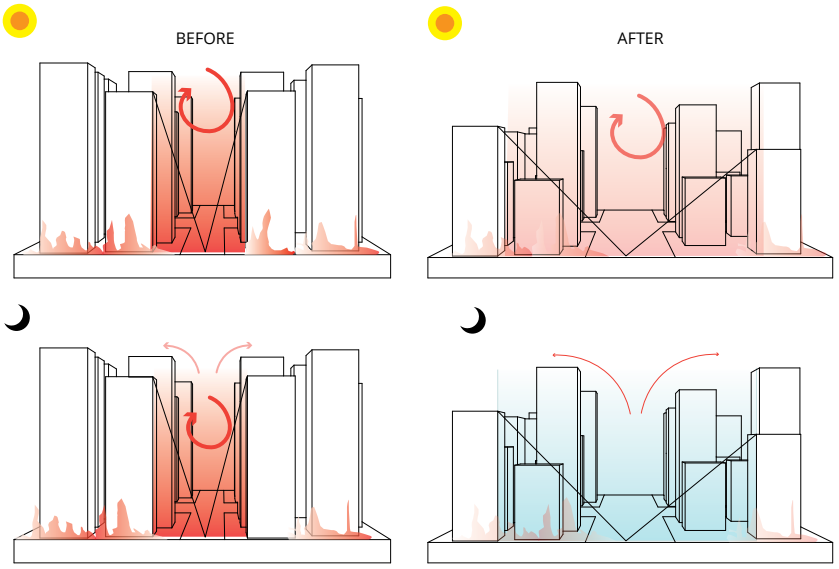


Figure 3: The diagram shows how taller buildings prevent streets from cooling at night and how building height could be modified to allow heat dissipation [Image credits: NYIT Urban Design Climate Lab 2017]

gation strategies generally signify that the benefits would far exceed the costs. For example, a 2018 study led by Greg Kats (current president of consulting and green investment firm Capital E who earlier helped create the LEED certification program) estimated the net present value (NPV) of widespread implementation of cool roofs, green roofs, solar photovoltaic arrays, reflective pavements, and urban canopy in three major U.S. cities. The results indicate that the NPV (the value of current and future cashflows) of implementing widespread cool design strategies could total in the billions.

Specifically, the calculated NPV "of citywide adoption of these technologies' ranges from $538 million for El Paso, Texas to $1.8 billion for Washington, D.C., and $3.6 billion for Philadelphia, Pennsylvania." If an estimated avoided loss for tourism is included (an area of uncertainty, so losses are estimated), the expected NPV for D.C. rises to $4.9 billion and for Philadelphia to $8.4 billion. The findings acknowledge that payback time and the net benefit per square foot for each strategy vary greatly.

Figure 4: The highly trafficked Third Avenue in the Gowanus neighborhood of Brooklyn in New York City has the characteristics of a "hot spot" where the lack of shade and concentration of dark, impervious surfaces create a microclimate of hotter temperatures and a location where pedestrians are more exposed to extreme heat. [Image credits: ULI NYC / The Fifth Avenue Committee]

Figure 5: Urban trees provide essential environmental services by minimizing the urban heat island effect, reducing air pollution, and managing stormwater. Cincinnati, Ohio has a dedicated funding stream for urban forestry that enables the city to grow and maintain these critical assets. [Image credits: Cincinnati Park Board]

Figure 6: Meaningful placemaking and an enjoyable user experience are common reasons designers and developers invest in heat-resilient design and amenities such as the Hilton Anatole's JadeWaters resort pool in Dallas, Texas. [Image credits: Hilton Anatole]

Implications of extreme heat for the real estate sectors relate to the durability of building materials, energy demand and consumption, outdoor space design, consumer location preferences and amenity expectations, regulation and taxation, and practitioners' insurance costs and professional liability risks. Many of these implications could ultimately impact real estate development projects' NPV. For example, UHIs increase the cooling load for a typical urban building by approximately 13 percent, but energy savings from cool design strategies can help offset these costs. Cool roofs, just one heat resilience strategy, provide an average yearly net savings of $0.50 per square foot.

The benefits of heat resilient development can be realized during project development, marketing, completion, and operations. As temperatures rise, developments that plan for extreme heat may gain a competitive advantage, whereas developments that are not prepared may incur costs. In *Scorched*, the Urban Land Institute identifies seven areas where these competitive advantages or costs could be realized:

- Consumer preference: Without intervention, extreme heat can be a stressor that influences consumer behavior. Buildings and developments designed to maintain comfortable temperatures are preferable to tenants, buyers, and retail consumers regularly experiencing extreme heat. Similarly, outdoor spaces that are designed to provide cooler environments may have enhanced use and foot traffic, translating into improved sales, branding, and visibility. In locations where extreme heat is a growing concern, amenity expectations – especially for air conditioning – may shift.
- Building longevity, maintenance, and operations: High temperatures can directly damage building materials and landscaping species not selected to

withstand extreme temperatures, leading to higher repair and replacement costs. Buildings not equipped for longer, hotter summers or not designed for potential future policy changes may require renovations and retrofits or have a harder time attracting new tenants.

- Business continuity: Extreme heat can contribute to other adverse events such as electrical grid failures, transportation interruptions, wildfires, and water shortages, all of which can cause human harm, business disruptions, and economic losses. Buildings and developments designed to be more prepared for these events have the potential to be more attractive to tenants, particularly in class A office space, and may also eventually be eligible for preferable insurance rates.
- Energy use: As temperatures rise, buildings relying exclusively on air conditioning for cooling will experience higher energy costs. Such dependency also becomes a risk when electrical grid stability is compromised by extreme heat.
- Liability: Extreme heat may increase the chances of lawsuits against developers and owners for system failures, degraded building materials, unstable operations, suffering tenants, and secondary impacts caused by buildings (such as glare damage). If more real estate professionals—especially in construction, architecture, design, and engineering—begin to consider extreme heat as part of their customary work process, the professional standards for successful, underperforming, or failed building could shift.
- Regulation: Regulatory measures may evolve to address extreme heat specifically, potential leading to required building or site landscaping retrofits. To raise revenue for major heat-resilient infrastructure investments, cities may also consider measures (taxes, bonds, etc.), some of which could potentially increase business costs.
- Regional market impacts: Given the effects on tenants and occupants, infrastructure, operating costs, and consumer behavior, there is risk that devaluation could occur because of extreme heat. Meanwhile, some locations with more temperate local climates may benefit. However, limited research to date has explored these questions.

HEAT RESILIENT POLICY: FROM EMERGENCY RESPONSE TO BUILDINGS

Public officials in historically cool and warm locations increasingly recognize extreme heat as a public health and infrastructure risk and are enacting heat-related policies to safeguard residents and to ensure functioning infrastructure. Although these policies conventionally addressed social and emergency services, they are gradually addressing issues relevant to land use, zoning, real estate, building, and public space design

Richmond, Virginia, for example, is using new heat vulnerability and heat illness maps to inform a comprehensive update of the city's master plan, including the consideration of zoning for future land uses. Similarly, in May 2019, Miami Beach enacted an ordinance that, among other actions, establishes review criteria to reduce the heat island effect of buildings and waives certain application fees for developments that use sustainable construction materials and vegetation that reduces UHIE.

Many cities with existing requirements related to extreme heat mitigation are updating them to higher, stricter standards. Requirements or incentives for cool roofs and shade cover are two common real estate–related heat-mitigation policies that have recently been updated in multiple locations, includ-

Figure 7: Participants in San Francisco's Neighborfest work together to map assets available locally in their community that they can use or share during events such as heat waves or power outages to stay healthy and safe [Image credits: San Francisco Department of Neighborhood Resilience]

ing in Los Angeles, California and Phoenix, Arizona. Increasingly, historically temperate locations such as Chicago, Illinois (cool roof requirements) and Portland, Oregon (green roof requirements) are adding heat-related policies.

The Urban Land Institute's *Scorched* research identified seven areas of potential heat policy innovation that are relevant to the real estate sectors:

- Citywide Temperature Reduction Goals: Similar to greenhouse gas emissions goals, several cities across the world have set temperature reduction targets. In Los Angeles, California the goal is to reduce UHI by 1.7°F by 2025 and average temperature 3°F by 2035. Melbourne, Australia's target is to reduce the city's average temperature 7°F by 2030.
- Expanded Urban Canopy and Greening Programs: Numerous cities in the U.S. have implemented tree canopy programs and some are using climate projections and heat vulnerability maps to direct greening resources to areas that need it most. Cities with existing, aggressive tree canopy and greening policies have, in some cases, maxed out public land, so future policy may target privately held land.
- Cool Wall Standards: The state of California, the U.S. Green Building Council via LEED (Leadership in Energy and Environmental Design), the Environmental Protection Agency via Energy Star, the American Society of Heating and Air-Conditioning Engineers (ASHRAE), and the Cool Roof Rating Council are considering new or enhanced cool wall provisions
- Rebates and Incentive Programs: Some cities are considering increasing the value of available rebates to encourage more widespread adoption of heat-mitigation strategies, such as green roofs, by the private sector.
- Thermal Comfort Polices: Cities are beginning to consider how to maintain or increase thermal comfort in the residential sector by, for example, im-

plementing air conditioning requirements or maximum allowable temperature standards. These are largely exploratory processes.

- Occupational Hazard Policies: Although there are currently no specific Occupational Safety and Health Administration standards for occupational heat exposure, there are a number of related safety requirements for employees exposed to high temperatures.
- Community Engagement and Connection Programs: governments are implementing programs and policies that encourage social cohesion. New York City's Be a Buddy pilot program is a partnership between the city, home healthcare agencies, and community health organizations to train attendants on how to recognize and treat heat stress, especially in vulnerable populations. San Francisco's has supported *Neighborfest*, an annual block party with activities to build social capital, train residents to become efficient conveners, and develop an asset registry for critical neighborhood resources. In July 2019, Philadelphia released its first Community Heat Relief Plan and toolkit, developed by a cross-departmental City working group, 30 community partners, five Community Heat Ambassadors, and community surveys.

HEAT RESILIENT DEVELOPMENT: SITE SCALE MITIGATION AND ADAPTATION

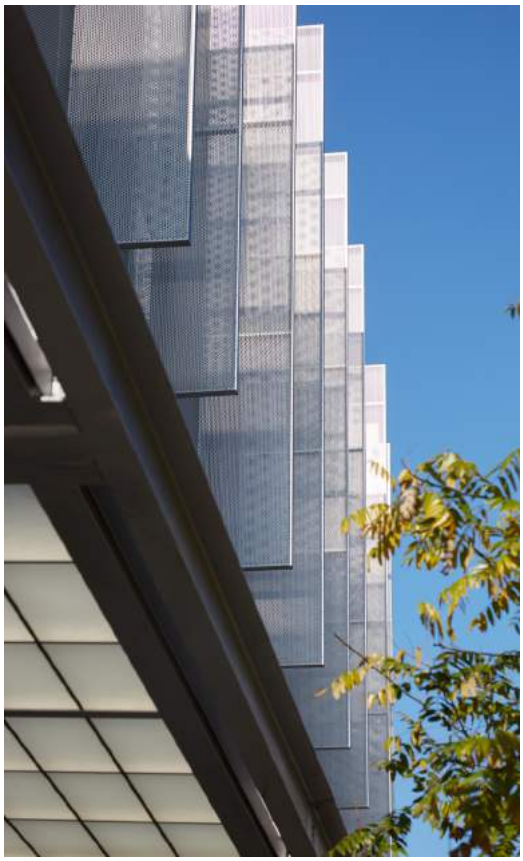
There is no "one size fits all" approach to extreme heat management, but significant opportunity exists to design and build to alleviate urban heat effects, safeguard human health, and create business value. Optimal planning and design methods to mitigate extreme heat differ depending on locational, climate, landscape, and density context and merit project-specific consideration. As extreme heat becomes increasingly prevalent because of the urban heat island effect and climate change, designing for heat and ensuring users' comfort is likely to become a mainstream concern.

For many heat-focused developers and designers, quality of user experience, ensuring consistent usability, and managing costs are key motivations behind choosing heat resilience strategies. To achieve these objectives, most heat-aware developments are incorporating traditional and innovative strategies at the building and site scale. Many project teams are also partnering with third party organizations – consultants or universities – to measure temperatures and better understand the impact of their efforts.

Edison Eastlake is an affordable redevelopment project under construction in Phoenix, Arizona that exemplifies many building-level mitigation strategies guided by public health considerations. Supported by a $1.5 million U.S. Department of Housing and Urban Development (HUD) Choice Neighborhood Planning and Action Grant and $193 million from the city, the City of Phoenix Housing Department is redeveloping 557 outdated public housing units into a mixed-income community of more than 1,000 new homes.

The Edison Eastlake One Vision Plan, led by design firm Mithun and created with residents and stakeholders, lays out the strategy for redevelopment and identifies cooling the urban heat island effect as one of three top implementation priorities. To inform the design, the city, supported by community organizations Local Initiatives Support Corporation–Phoenix and Vitalyst, conducted a detailed neighborhoods Health Impact Assessment survey. The survey found that urban heat was one of three top concerns for residents who identified heat-related health concerns, including respiratory and cardiovascular disease, specific heat illness, and lack of ability to walk safely.

To address these concerns, the project team developed housing prototypes



to mitigate extreme heat by maximizing shade and ventilation and incorporating cool building materials. Courtyard housing maximizes shade, and single-loaded apartments with open breezeways on one side and apartments that have operable windows on both sides allow for cross ventilation. Planned common facilities will have backup water supply and generators and are centrally located to minimize social isolation – a common risk factor in many fatal extreme heat cases. Phoenix Housing is also coordinating with Arizona State University researchers who have installed multiple weather stations in the neighborhood to measure baseline temperatures and track temperature change from construction through buildout.

Heat-aware project teams are balancing trade-offs and testing new technologies to create year-round enjoyable experiences – especially outdoors. Local conditions, such as humidity level and precipitation, determine which heat mitigation and adaptation strategies will be effective and appropriate.

An example of this is Bagby Street, a redeveloped, four-lane corridor in Houston, Texas. The project team wanted to attract development and enhance the neighborhood culture while minimizing costs and water use in a drought-prone environment. Project partners worked with the local utility to replace overhead utilities onto taller poles and to consolidate poles on one side of the street. They also aligned Bagby Street's irrigation infrastructure with a nearby park. Those changes allow new shade trees to grow larger before needing to be trimmed, reducing maintenance costs, and have resulted in an annual 10 percent water bill reduction even with additional shade plants.

Figure 8 (left): Custom housing prototypes with central courtyards, open breezeways, and operable windows help maximize shade, ventilation, and energy efficiency at Edison Eastlake in Phoenix, Arizona [Image credits: Mithun / Tim Griffin

Figure 9 (right): The absence of utility poles on one side of Bagby Street (Houston, Texas) is an intentional strategy to eliminate overhead conflicts with big, effective shade trees and reduce maintenance costs [Image credits: Design Workshop]

Figure 10: Eye-catching, mechanically operated functional shade umbrellas were well worth the extra cost at Sundance Square Plaza (Fort Worth, Texas); the plaza's heat-conscious renovation has increased foot traffic, retail sales, and real estate value in the surrounding neighborhood [Image credits: Michael Vergason Architects]

Figure 11: Parks and open spaces mitigate the urban heat island effect and reduce the impact of extreme heat. In historically hot downtown San Antonio, Texas, Yanaguana Garden at Hemisfair Park provides sanctuary with shade, green space, and a water play area, and other amenities [Image credits: Hemisfair Park Area Redevelopment Corporation]

Another national trend for creating year-round heat-resilient and financially successful spaces is to install innovative, functional art pieces. Two places that have adopted this shading and placemaking solution are Skysong, a 42-acre mixed-use development in Scottsdale, Arizona and Sundance Square Plaza, a 2-acre community space that is the centerpiece of redevelopment in downtown Fort Wort, Texas. The developers of Skysong commissioned a custom-built 150-foot-tall "shade sail" to designate and protect an outdoor central gathering space. At Sundance Square Plaza, 86-foot mechanically operated umbrellas provide almost 5,800 square feet of shaded space. At night the umbrellas are illuminated by multicolored LED lamps, and can easily be closed on cooler days when the sun's warmth is welcome.

INDUSTRY-WIDE IMPACT

Widespread adoption of temperature reduction strategies could potentially reduce or even offset the urban warming trends currently occurring in cities, particularly the urban heat island effect, leaving cities to contend with a more manageable 1° to 2°F climate change increase, not the current 5° to 22°F urban heat island impact.

Developers, owners, property managers, and policymakers across the United States can start taking steps towards heat-resilience by first assessing and monitoring long-term risks from extreme heat over the lifetime of a building, development, or city to understand the likely impacts on users and community members. Practitioners can then consider which heat-resilience strategies to implement and how to contribute locally to community preparedness and response strategies for extreme heat.

With thoughtful design and consideration of temperature-related risks, real estate and land use practitioners can mitigate the effects of extreme heat on people and infrastructure, realize the business benefits of early resilience leadership, and contribute to the long-term success and livability of communities.

The Urban Land Institute is a is a 501(c) (3) nonprofit research and education organization dedicated to providing leadership in the responsible use of land and supported by more than 46,000 members worldwide. Read the full text of Scorched: Extreme Heat and Real Estate at *uli.org/extremeheat* and find additional case studies of climate resilient development at *https://developingresilience.uli.org/*.

Endnotes

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Climate Action Plans:
An Essential Planning Tool for Cities

Christian Horn

Coexistence of bicycle, tram and waterways in Paris
Credits: Christian Horn, RETHINK

I CLIMATE CHANGE

Climate change is happening and at a faster pace than ever recorded before. Indications of this include summers now marked by multiple wildfires on nearly all continents; heat waves, melting glaciers, thawing of permafrost, water shortages, the reduction of the biodiversity and other environmental occurrences.

From the 1950s onwards scientists and others started to warn about the negative impact of human activities on the ecosystem of the earth. Rachel Carson's 1962 book, Silent Spring[1], documented the environmental damage caused by the indiscriminate use of pesticides. In 1972, the Club of Rome stimulated considerable public attention with its report, The Limits to Growth[2]. This study suggested that economic growth could not continue indefinitely because of resource depletion. Translated into 30 languages, it became the best-selling environmental book in history. In 2006 the movie An Inconvenient Truth[3] documented former United States Vice President Al Gore's campaign to educate people about global warming further raised awareness of global warming internationally. At a local level, the transition network emerged, in 2007, to connect and support grassroots community projects that aim to increase self-sufficiency, balance and independence from fossil energy. Rob Hopkins described this concept in the book The Transition Handbook[4]. This concept continues to spread to all continents. But the voices of these forerunners stayed mainly unheard and did not alter human behavior. Despite that, the World Health Organization website predicts that between 2030 and 2050, climate change is expected to cause approximately 250 000 additional deaths per year[5]. For example, the worldwide use of pesticides has constantly increased since Rachel Carson's 1962 book, contributing to the loss of biodiversity[6] and contaminating our environment[7].

It is only recently that the general public in many countries seems to be giving more attention to the protection of our planet. The visible signs of climate change, with its tangible negative impact on the health of humans and wildlife, prompted a strong mobilization of the youth and produced school strikes for the climate movement- Fridays for Future. These events will hopefully change people from being a spectator to become actors against climate change.

Figure 1: A Fridays for Future demonstration in Paris in 2019
Credits: Christian Horn, RETHINK

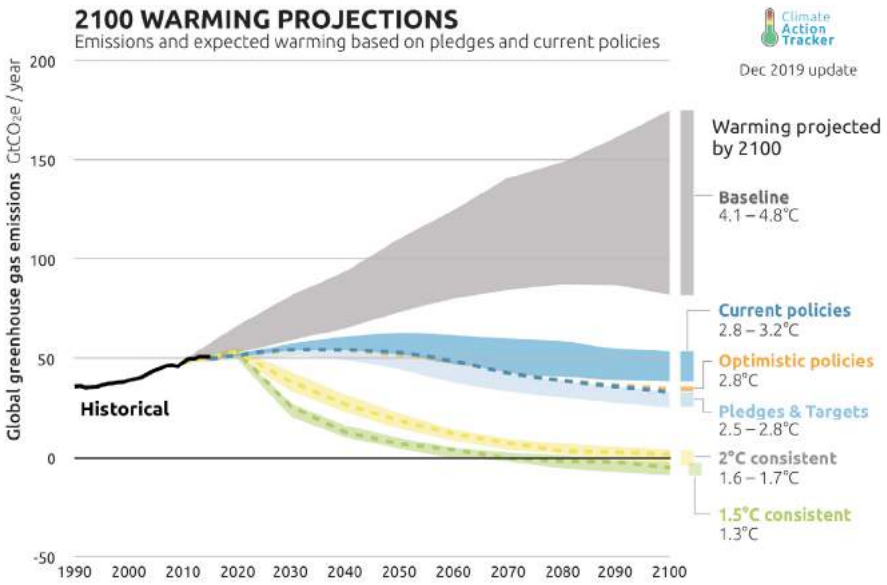

Figure 2: Today's 2100 global warming projections. Credits: Climate Action Tracker 2019

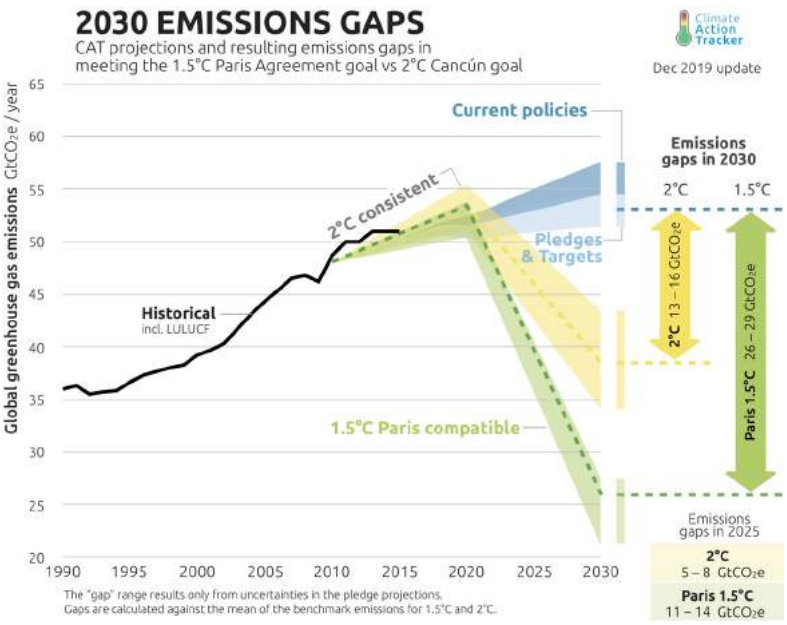

Figure 3: Today's 2030 emissions gaps. Credits: Climate Action Tracker 2019

THE PARIS AGREEMENT

The Paris agreement, based on the negotiations of the 21st Conference of the Parties in Paris (COP21) in December 2015, the intent is to contain global warming well below +2°C (compared to pre-industrial levels) by 2100, and it strives to limit the increase to +1.5°C. A major focus of this climate change agreement is to limit the amount of Greenhouse Gases (GHG) being emitted. 197 countries have signed the Paris agreement and it came into force in November 2016 after it has been ratified by 55 countries representing at least 55% of the estimated greenhouse gas emissions. It requires countries to put forward national climate action plans, called Nationally Determined Contributions (NDCs), and to periodically report on their progress towards implementing those plans. But it leaves it up to each country to determine the plan's content and level of ambition.[8]

Today, five years later, the achievement of the Paris Agreement is more difficult than in 2015 due to the lack of political will of most governments, resulting in five lost years. The Climate Action Tracker (CAT), developed and updated by three research organizations, with experience tracking climate action since 2009, shows a gap between the objective of the Paris agreement and the objectives of the today's national climate action plans. It also reports a second gap between the objectives of the national climate action plans and the total level of measures they have implemented. The Tracker reports estimate that the existing national climate action plans will lead to an increase of 3.0°C to 3.3°C, above pre-industrial levels, by the end of the century. This forecast is well above the emission pathway consistent with the Paris Agreement long-term temperature goal of 2.0°C to 1.5°C.[9]

The Emissions Gap Report of 2019 of the United Nations Environment Programme notes a similar conclusion. Issued annually since 2010, the report indicates "despite a decade of increased focus on climate change, global GHG emissions have not been curbed and the emissions gap is now larger than ever". "Dramatic strengthening of the NDCs is needed in 2020. Countries must increase their NDC ambitions threefold to achieve the (well below) 2°C goal and more than fivefold to achieve the 1.5°C goal."[10]

While the consequences of climate change are becoming more visible, countries and government are divided about the consequences of their national policies. The spectrum ranges from denial, ignoring and minimization, to overly simple acknowledgement with limited or contradictory actions. The disappointing results of the 2019 United Nations Climate Change Conference (COP25) show the difficulties of a majority of national governments to engage on efficient climate actions plans without any pressure by international binding obligations to implement the Paris agreement.

THE IMPORTANT ROLE OF CITIES TO ACHIEVE PARIS AGREEMENT GOALS

Given this stagnation at the national level to reduce GHG, the role of not-state and subnational actors[11] is becoming important and their voices are being heard. For example, it took until 2015 to include the assessments of the role of their actions into the Emissions Gap Report of the UN Environment Programme. Also, new types of international cooperative programs now are emerging, in parallel with negotiation on the national level, which gather all actors who are determined to work on the ecological transition. These cooperations are characterized by multi-country and multi-actor engagements between countries, regions, cities, companies, associations and citizens.

Cities have taken an important place in the development of the human society.

Figure 4: The city of Paris and its agglomeration
Credits: Christian Horn, RETHINK 2019

Figure 5: The cityscape of central Paris
Credits: Adrian Diez 2012 / CC BY-SA 3.0

According to the Institute Paris Region[12] cities accommodate about 55% of the world's population, emit 70% of global greenhouse gas emissions and host 80% of the wealth while covering only 2% of the land surface. They represent the main places of political, economic, social and cultural decisions. What happens and is decided in cities has a large impact on whole countries. So, cities have to take an active part in the development of programs to reduce GHG emissions.

To implement the objectives of the Paris agreement in their municipal territory many cities developed municipal climate action plans to become carbon neutral by 2050. In 2019, over 70 large cities, housing 425 million people, have committed to go carbon-neutral by 2050 or sooner[13]. This objective signifies efforts to reduce the major part of all CO_2 emissions and to offset the remaining irreducible emissions generated by human activities. Below are two examples of such plans. The first described the Paris plan and the second describes Berlin's measures.

I THE PARIS CLIMATE AIR AND ENERGY PLAN

The city of Paris, capital of France, houses about 2.2 million inhabitants within an agglomeration of 10.7 million inhabitants. It is the political, economic and cultural capital of France. With 20,800 hab./km², it is one of the most densely populated cities in Europe. Paris's territorial total greenhouse gas emissions (carbon footprint) was 25.6 million tons of CO_2 ($mtCO_2$) in 2014, which can be divided into two major categories. First, direct emissions from the Paris area related to the energy consumption of the residential, tertiary/service and industrial sectors, city centre transport and the emissions associated with the waste produced in Paris. The second category consists of the carbon footprint of the territory (6.0+19.6 $mtCO_2$ in 2014); local emissions plus the upstream emissions produced before energy consumption, emissions associated with the food and construction sectors, and from transport outside Paris (including air transport).

In 2004 the city began studying its GHG-related activities and in 2006 published its first greenhouse gas assessment. It revealed the most highly emitting sectors were public facilities (56%), public transport (20%) and consumer goods (24%). Based on this analysis, Paris developed and adopted its

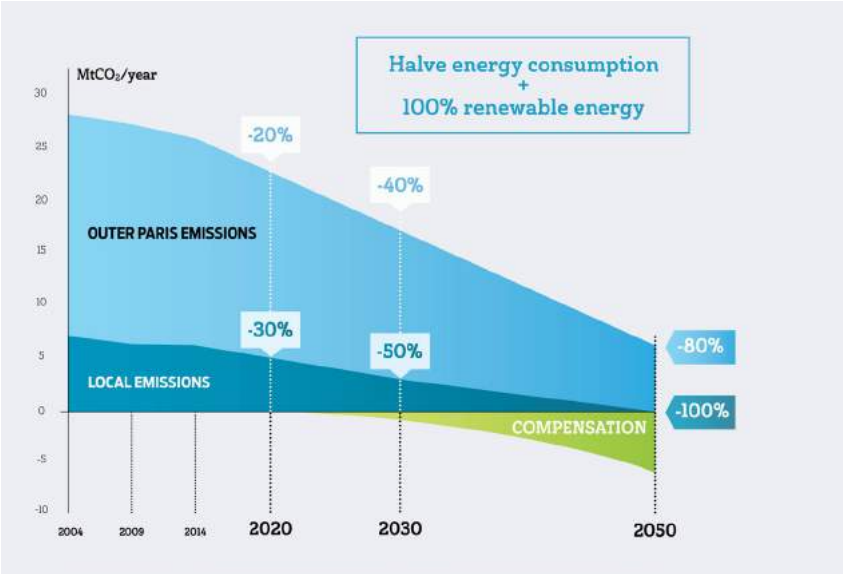

Figure 6: The carbon reduction pathway of the Paris Climate Plan
Credits: City of Paris 2019

Figure 7: Market gardening in the Paris region
Credits: Christian Horn, RETHINK

first climate action plan in 2007 which intended to reduce its greenhouse gas emissions. This plan was updated ten years later in 2018[14]. In line with the objectives of the Paris Agreement, by 2050 the City of Paris proposes to: reduce local emissions by 100%, achieving the goal of zero emissions in Paris; and, promote an 80% reduction in the carbon footprint of Paris compared to 2004 levels. It also proposed to involve all local stakeholders in compensating for residual emissions, to attain the zero net carbon target for the Paris area. To reach these objectives the city set up an operational action plan for 2030 and an ambition for 2050. Essential 2030 targets were: a 50% reduction of local CO_2 emissions; a 40% reduction of the Paris carbon footprint; a 35% reduction of energy consumption; using 45% of renewable energies in overall consumption, including 10% locally produced; and, becoming a zero-fossil fuel and domestic heating oil area.

The plan for 2030 is structured into six main categories: energy; mobility; buildings; urban planning; waste, and food. These are recurrent themes in climate action plans as they represent the main CO_2 emissions. The following are some examples of actions to be undertaken in these categories.

- **Energy**
  - Establish a local energy governance system.
  - Produce renewable energy within the Paris region.
- **Mobility**
  - Reduce traffic and enhance active mobility.
  - Support low-carbon urban logistics.
- **Buildings**
  - Renovate 100% of the existing building stock to reduce energy consumption by heating or cooling.
  - Reduce housing inequalities and encourages social links.
- **Urban planning**
  - Target carbon neutrality for all new urban projects.
  - Create temporary urban projects on vacant sites, to avoid empty spots and develop a city of short distances.
- **Waste**
  - Reduce primarily waste of packaging and food.
  - Support the growth of the existing recycling centers.
- **Food**
  - Reduce the average supply distance for foods.
  - Introduce vegetarian days in institute caterings, as livestock contributes to GHG emissions.[15]

The drafting, detailing and ratification of a climate action plan is a necessary step for every city to assumes its responsibilities for the future. But the next, and more difficult step, is to implement the plan and to translate it into practical measures. However, even if all the actions that the city of Paris can implement directly (like the renovation of municipal buildings or the replacement of municipal vehicles) were accomplished the city can only fulfil 20% their climate action plan objectives. The other 80% of the objectives are directly depending on the actions of all other stakeholders. To achieve the climate plan objectives, it is crucial to involve all stakeholders: public and private entities, associations and citizens. Without convincing these stakeholders to actively participate and to adapt their habits, every climate action plan will fail to reach its objectives. One-way Paris has actively stimulated participation since 2014 is to allocate 5% of its annual investment budget for projects proposed and voted by the inhabitants.

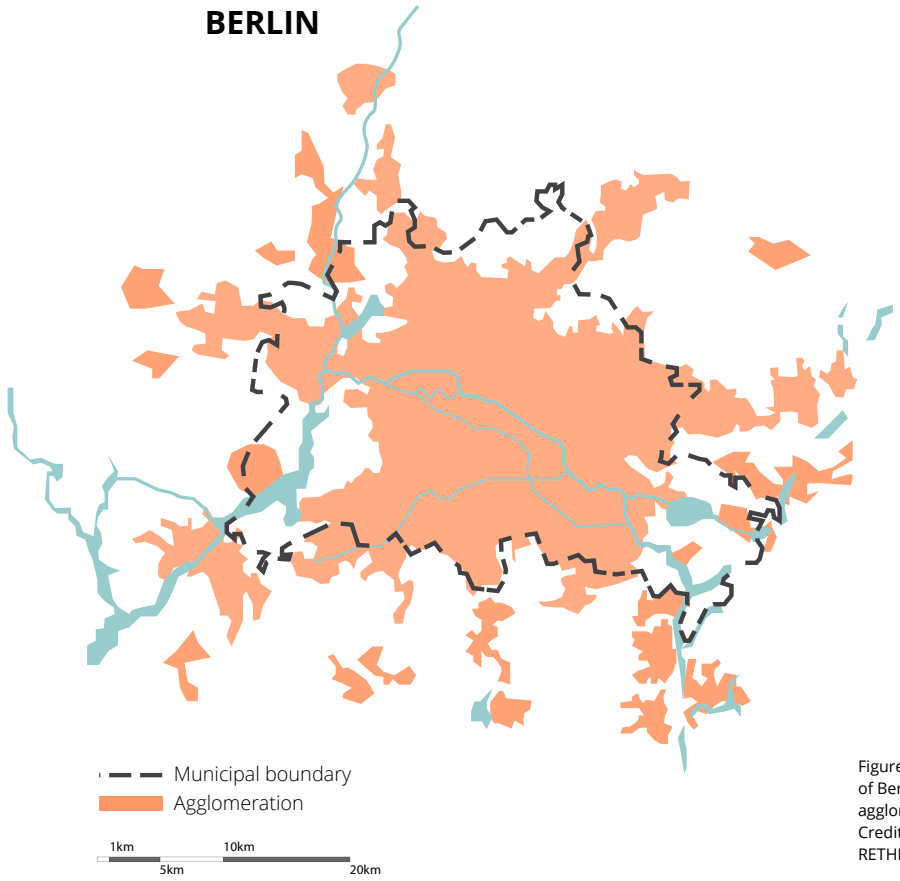

Figure 8: The city of Berlin and its agglomeration
Credits: Christian Horn, RETHINK

Figure 9: View from Berlin Victory Column to Großer Tiergarten, Brandenburg Gate, and Berlin TV Tower, 2013
Credits: Alexander Savin, WikiCommons

THE BERLIN CLIMATE AIR AND ENERGY PLAN

Berlin is the capital of Germany and a city-state of 3.6 million inhabitants within an agglomeration of 4.5 million inhabitants. It bears the image of a green city because more than 40% of its surface is green spaces and the city is surrounded by agricultural areas. The population density is 4,203 hab./km².

Following the current trajectory of climate change, the climate of Berlin in 2100 will resemble that of the city of Toulouse in southern France today. To avoid this and to respect the Paris agreement, the city of Berlin likewise has the objective to become carbon neutral for 2050. To reach this objective, the climate action plan of Berlin was developed and in 2018 entered the implementation phase[16]. The plan proposes 100 measures to work towards climate protection and to adapt to the consequences of climate change. The current implementation phase is funded with 94 million Euros until 2021, which is the year of the next local elections. The development horizon of the plan is 2030. In this plan, the sum of all CO_2 emissions of Berlin must decrease, relative to the 1990 base year, by 60% by 2030 and by 85% by 2050. These objectives seem to be slightly higher than those of Paris with its proposed decreases by 50% by 2030 and 80% by 2050. Also, the Paris reduction targets are relative to 2004 conditions while the Berlin targets are related to 1990 conditions. This makes a direct comparison difficult.

The 100 measures of the Berlin climate action plan are grouped into the following six categories. To supervise its implementation, a monitoring report is produced every two years, with an annual interim monitoring report.

- **Energy**
  - Reduce the energy demand;
  - Change to a decentralized, flexible, safe and socially responsible energy provision based on renewable energies;
- **Building and urban development**
  - Increase the rate and extent of energy efficient renovation of the existing building stock,
  - Change the rate of urban densification (“city of short distances”).

Figure 10: The large public park Gleisdreieck
Credits: Christian Horn, RETHINK

- **Economy**
  - Increase energy efficiency and substituting fossil fuels through a mix of consulting, networking and promotion.
- **Transport**
  - Strengthen the environmental mobility network by making walking and cycling more attractive
  - Increase alternative drive systems and reducing fuel consumption.
- **Private households and consumption**
  - Foster climate-friendly behavior through advising, educating and providing support.
- **Adapt to the impacts of climate change**
  - Emphasis on the health, urban development, urban greenery, forestry, trans-port, commerce and finance sectors.

COMPARISON OF THE CITY PLANS – AN EXAMPLE USING MOBILITY

Even if they look similar on a first glance, climate action plans must be adapted in detail to the characteristics and potentials of their territory. This can be seen in the measures of Paris and Berlin towards petrol and diesel vehicles.

The Berlin climate action plan foresees that by 2030 petrol and diesel-powered vehicles will make up only about a third of all road vehicles and should be almost completely replaced by 2050. The Paris climate action plan instead targets the phasing out of diesel-powered vehicles by 2024 and calls for the end of petrol-powered mobility by 2030. In detail, while Paris targets to forbid petrol and diesel vehicles completely by 2030, the Berlin hopes to 'almost' replace them by 2050, twenty years later than Paris and not even completely.

This difference in ambition comes from the geography of the cities. The city of Paris covers the dense center of the Paris metropolitan area and benefits from a well-developed public transport system, an extensive network of cycle paths, and waterway routes along the river Seine and its canals. These

Figure 11: The public bike share service in Berlin
Credits: Christian Horn, RETHINK

assets facilitate a strong ambition for mobility issues. The municipal boundary of Berlin is more extended and includes a large part of the periphery of the agglomeration. In these low-density areas, the public transport system is less developed and active mobility less efficient because of the longer distances. In consequence, the inhabitants of Berlin are seen to be more dependent on car use for their everyday needs than those in Paris.

But the low population density of Berlin and the strong presence of green spaces give the city a higher capacity to avoid and reduce urban heat islands than the densely built city of Paris, that can only rely on the flat roofs of some of its buildings for revegetation.

THE DIFFICULTIES IMPLEMENTING CLIMATE PLANS

The drafting, detailing and ratification of a climate action plan is an indispensable step, but the main step is to implement the measures of the plan. Berlin has had difficulties achieving its objective to reduce CO_2 emissions by 40% by 2020. Although the city has reduced its CO_2 emissions by about a third since 1990, an upward trend in emissions and energy consumption has been observed in recent years. In 2016, there was a total of 20 $mtCO_2$ (Paris: 25.6 $mtCO_2$ in 2014). Compared to the 1990 base year, this represents a decrease of 31.4%, but compared to the previous year 2015, it was an increase of 2.9%. Instead of constantly reducing the CO_2 emissions, the emission trajectory turned and increased between 2015 and 2016. One possible reason is that few of the 100 measures of the climate action plan have been implemented in 2019. The majority still remained at the concept stage. As a result, only 23 million EUR, of the 94 million EUR total budget until 2021, has been spend or budgeted for concrete measures[17]. Another reason is that Berlin has a growing population. But the objectives of the reduction of CO_2 emissions are counted in total value (40% reduction in tons of CO_2 to the 1990 base year), independent of the number of inhabitants. So, each time a new citizen adds their carbon footprint to the existing CO_2 emissions, the city has to reinforce its efforts to maintain its goals.

Another implementation challenge is that some measures will face resistance from a part of the population as it implies changes to our habits and might imply constraints. National and local governments hesitate to impose unpopular measures, as they dread to lose the support of the population during a mandate and not to be re-elected. Though long-term political support for climate action plans and their continuous implementation and improvement are needed.

When cities implement new structural policies, like changing from a globalised food supply to a regional food supply while reducing meat production, the GHG emission gains are small at the beginning. They are thin and uncertain, but they increase over time. Only the necessary period to reveal

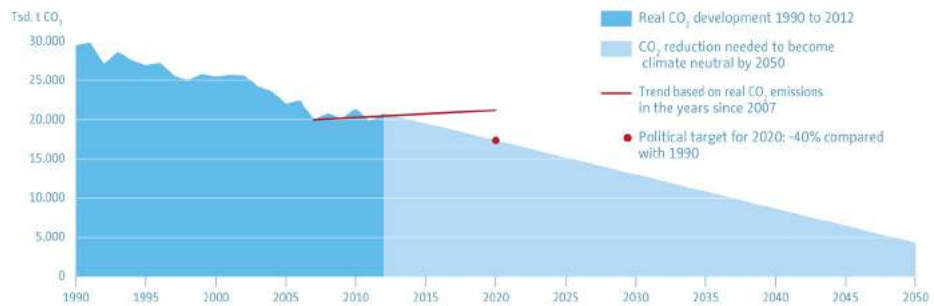

Figure 12: The Berlin's CO_2 emissions since 1990, the trend and the actions required by 2050 Credits: Berliner Energie- und Klimaschutzprogramm

the positive effects of the new policy is often longer than the mandate of an elected representative. In the first years, citizens might perceive the changes as constraints to their habits, without yet observing the positive effects on life quality and noticing the reduction of GHG emissions.

This is where the sensitization, explanation and participation processes to gain the support of the inhabitants becomes important. A best practice example is the closure of the Seine river expressway, Georges Pompidou, that had been progressively conducted between 1995 and 2016 by 4 succeeding mayors of different political parties. While in the 1990s it was unimaginable for the majority of the population to close this inner-city expressway, different well-planned steps managed to change their opinion and to show the positive effects of its pedestrianization. With the result that by the 2010s the population demanded its closure.

This example shows that strong public support is as essential as the political. Citizens must get involved in the ecological transition. They should claim the development and ratification of climate action plans from the local governments. With public support and demand, the main political parties will follow up its implementation. In Paris ecology has become one of the priorities for the citizens and as a consequence a subject for all the main political parties. However, each party has different interpretations of what should be done and different ambitions. Not all of the party goals conform with the Paris agreement and the path towards carbon neutrality by 2050.

In Europe, the opposition to constraints is diminishing, as the negative effects of climate change become perceivable. Discussions in the European Union to proscribe short distances flights, if an alternative by high-speed trains is available, show that coercible measures are not unimaginable any more if combined with reliable alternatives. And the petrol and diesel-powered vehicles might be a relic of the past in 2030 in Paris according to the actual climate action plan.

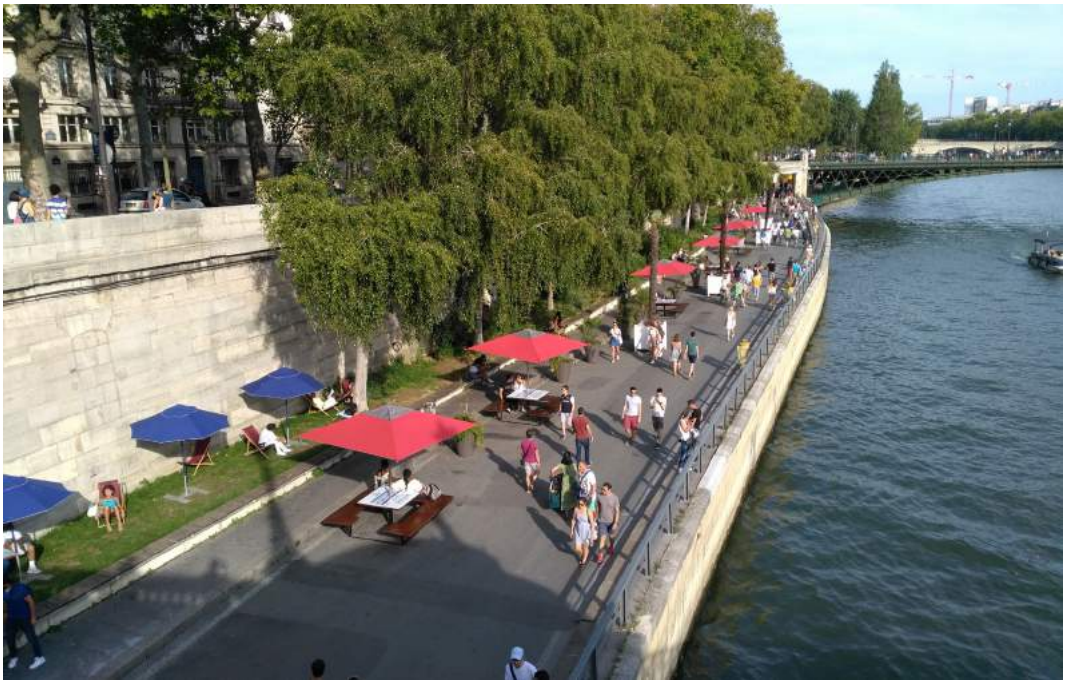

Figure 13: The former Seine river expressway is now a public promenade
Credits: Christian Horn, RETHINK

SUMMARY

The ecological transition to limit climate change is one of the main challenges of the first half of the 21st century and cities have an essential role in this transition. An ambitious climate action plan, based on a detailed assessment, has to define strategies and become a dynamic tool to guide the development of the city in all aspects, both short and long term. The implementation of the strategy has to be proceeded and accompanied by information and participation processes with all stakeholders, public and private. Private stakeholders have to become active participants in the ecological transition process since as much as 80% (in the case of Paris) of the objectives of the climate action plan are depending on non-governmental action and change in behavior. City governments have to be exemplary in their ambitions and actions, but citizens, professionals and companies are the main source of CO_2 emissions and they have a major impact in the ecological transition.

Architects and planners, who sharp the future of the cities, have to get directly involved as professionals and citizens in climate plans. They need to engage now as this decade will be essential for bending the emissions curve and bridging the emissions gap. Some cities already show the way, like Copenhagen which has been implementing its climate action plan since 2013 and aims to be the world's first carbon-neutral capital city by 2025. Oslo and the Hague also have 2030 objectives. To get involved, architects and planners can study the climate actions plan of cities and regions. These documents are rich sources of information. The 17 sustainable development goals (SDG) of the United Nation also offer a general guideline to orientate and verify the sustainably of urban projects. To support the SDG, UN-Habitat publishes online monthly best practices in city planning and urban projects[18]. This acquired knowledge will change our way to think and build our cities and their environment.

Planning professional can take advantage of their access to city officials to raise awareness on the risk and consequences of climate change and the positive impact of climate actions on the local level. For example, most cities that have implemented ambitious measures for sustainability for a decade or more now ranked among the most attractive cities. Places like Freiburg im Breisgau (Germany) or Malmö (Sweden) are good examples as they experienced demographic and economic growth while reducing their carbon emissions.

We can encourage the introduction of sustainability issues in schools and universities is essential to train and exchange with the future planners. These issues are not yet sufficiently integrated in academic studies and they should be present from the first year onwards. Schools and universities can place themselves on the forefront of ecological transition and work closely with all state and non-state actors.

Local activities on district or neighborhood level have a strong impact. We can join local city councils and organize conferences and debates in neighborhoods. Architects and planners need an informed and sensitized the public to get support for building and planning with the objective of carbon neutrality by 2050. Local democracy, debates and

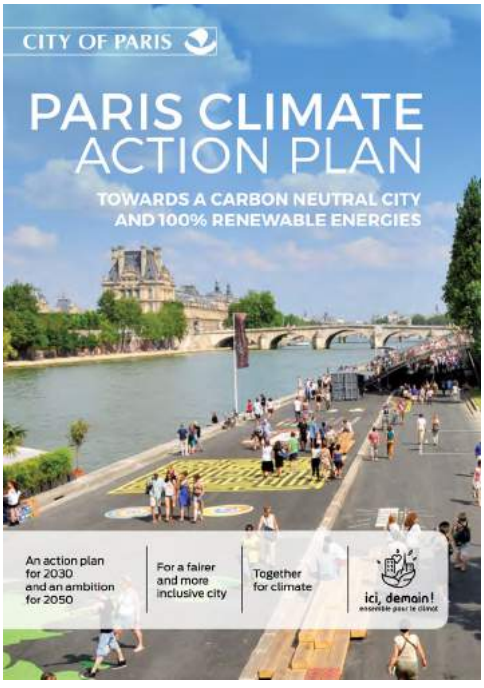

Figure 14: Paris climate action plan 2018. Credits: City of Paris 2018

freedom of speech, is essential for this transition process. City governments can join different networks, like the Global Covenant of Mayors, that gathers more than 10,000 cities across 6 continents and 138 countries and represent over 864 million people, or more 10% of the global population.[19]

The world has to become carbon neutral by 2050 to contain global warming well below +2°C compared to pre-industrial levels by 2100. The knowledge and first return on experience on strategies, action plans and their implementation to attain this goal is emerging and available. As a professional, we now have to learn, convince our clients and apply this knowledge on all our projects to keep earth inhabitable across all counties and region for all living beings.

Endnotes

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7 Parts of the French West Indies had been contaminated for generations by the chlordecone, an insecticide banned globally by the Stockholm Convention on Persistent Organic Pollutants signed in 2001.

8 All countries on the Arabian Peninsula have signed and ratified the Paris agreement in February 2020. Besides Yemen that signed but did not ratify the agreement yet. Since 2015 a civil war is ravaging Yemen, making a normal governance impossible.

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18 https://unhabitat.org/knowledge/best-practices

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Figure 15: Les Grands Voisins, a temporary occupation of a building site in transition
Credits: Christian Horn, RETHINK 2017

Co-Creating Local Energy Transitions Through Smart Cities: Piloting a Prosumer-Oriented Approach

Tjark Gall, Giulia Carbonari, Annemie Wyckmans, Dirk Ahlers

Aerial photo of award-winning positive-energy complex 'Gardens International' in Limerick

A key future challenge is to provide decentralized and sustainable energy (Rifkin 2011). Given that challenge, the theme of Post-Oil City asks how this can be accomplished for cities and regions which evolved using fossil fuels.

The Horizon 2020 innovation project Positive City ExChange (+CityxChange) responds to this challenge and to the Sustainable Development Goals (SDGs), New Urban Agenda, Paris Agreement, as well as the Sustainable Energy Transition Plan and Green Deal of the European Union. It implements an innovative demonstration-driven approach in the context of smart cities by enabling participatory innovation environments and opening energy markets to decentralize and prosumer-oriented models. It focuses on strong integration within the public sector and co-creation across stakeholders and citizens.

Positive City ExChange is one of 17 ongoing or completed European Smart Cities and Communities Lighthouse projects to develop and implement solutions for: 1). secure, affordable and clean energy; 2). smart electro-mobility; and, 3) smart tools and services in over 100 cities. The +CityxChange consortium unites the two lighthouse cities Trondheim (Norway) and Limerick (Republic of Ireland) with the five follower cities Alba Iulia (Romania), Písek (Czech Republic), Sestao (Spain), Smolyan (Bulgaria), and Võru (Estonia) to achieve sustainable urban ecosystems that establish 100% renewable energy city-regions by 2050 as part of the European energy transition. The project enables the co-creation of the 'future we want to live in'. It develops frameworks and supporting tools to enable a common energy market supported by a connected community and integrated with cities' urban planning, as well as new policy intervention, market (de)regulation and business models that deliver positive energy communities and integrate e-Mobility as a Service (eMaaS).

This article discusses how the +CityxChange project creates an enabling environment for the societal and technical innovations that are required to transition towards positive energy blocks, districts and cities, for, with and by citizens. Eighteen months into the project, the portfolio includes, amongst others, instruments for novel policy intervention, community engagements, market (de-)regulation and business models that enable scaling-up and replicating Positive Energy Blocks and Districts across cities in and outside the European Union. The solutions include data and technology-centered projects as well as urban planning and citizen-focused elements, such as co-creating city visions and accelerating change and disruptive solutions through open innovation playgrounds and participatory governance.

The article focuses on the implementation, achieved results, learnings, replicability and impact on the urban planning sector – providing a practical course of action for the Post-Oil City.

BACKGROUND

To reach the goals of the European Energy Transition, massive decarbonization and energy production alternatives need to be rolled out. Such ambitions are part of major 'top-down' European climate and energy strategies, such as the European Green Deal, many national strategies, and also ambitious municipal plans, such as C40 initiatives, Covenant of Mayors, individual Sustainable Energy Action Plans and many more. These energy transitions need to take place within the broad and ambitious framework of the UN Sustainable Development Goals (SDGs).

The question is how do we get there? What are promising approaches for such complex challenges? Who are the relevant stakeholders and what are the structures, and barriers related to implementation, piloting, and scaling? How can cities and citizens adapt and rise to the challenge?

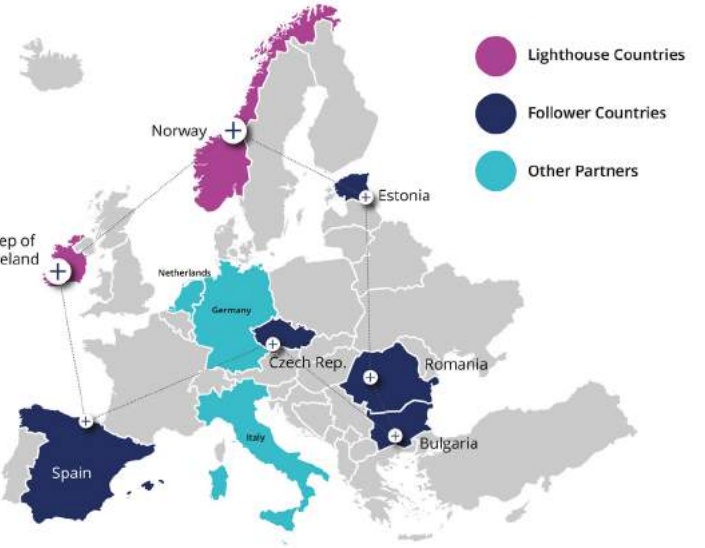


Figure 1: Lighthouse, Follower and Partner countries and cities of +CityxChange

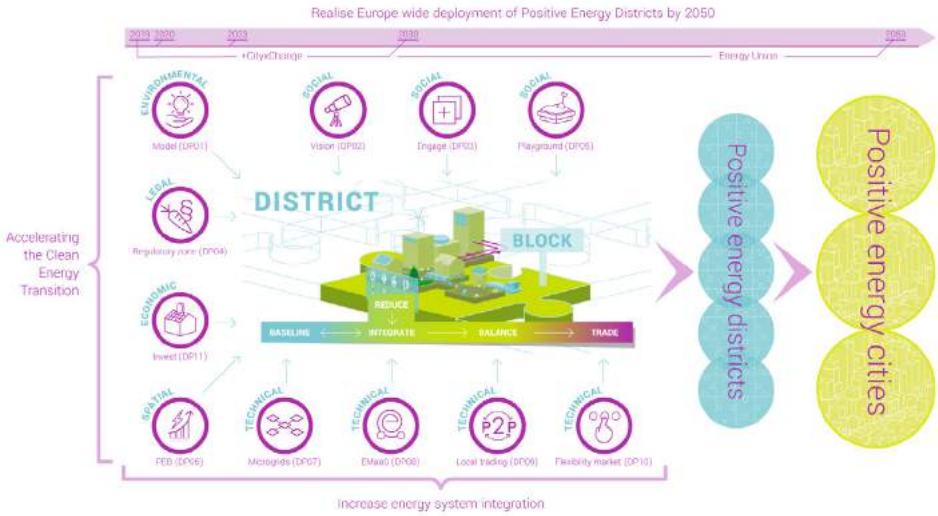


Figure 2: Approach for scaling from Positive Energy Blocks to Cities, based on 11 demonstrations

Experiences of the other European Smart Cities and Communities projects have shown that discipline-specific approaches are not capable of handling complex urban and societal challenges. However, common barriers and solutions exist and are being identified (Vandevyvere 2018, Borsboom-van Beurden 2019). Cross-disciplinary and sectoral co-creation is a better way to develop transition pathways for cities and communities to becoming energy positive. However, such high-impact approaches are challenging to implement.

As one complementary 'bottom-up' approach, the European Horizon 2020 Research and Innovation program has, for six years, been running the funding scheme of 'Smart Cities and Communities' Lighthouse projects for large scale demonstrations. Currently there are 17 projects in this scheme.[1] It focuses on topics of energy systems integration and urban energy transition with a city perspective and fosters innovation and replication.

+CityxChange is part of this project family. It started in November 2018 with a project duration of five years, including three years of development and deployment of demonstrations, and two years monitoring and replication to verify the validity and applicability of results. The project follows a very

local approach for each city and a cross-cutting approach between the cities for learning and knowledge exchange. The program works with cities as main partners, supported by local and international solution providers and universities. These partners collectively plan, implement and monitor physical, digital and social demonstration projects at the urban block and district level. The main goal is to develop and deploy Positive Energy Blocks and Districts, and ultimately Positive Energy Cities.

Eleven demonstration projects are arranged around this goal covering environmental, spatial, social, technical, economic, and regulatory aspects. The main aspects of the project are people, technology, and environment needed to develop Positive Energy Blocks and Districts and to foster replication.

How to handle the complexity of the challenge

In +CityxChange, we set out to develop a multi-disciplinary, multi-actor, and multi-country approach of co-creation and open innovation (Curley and Salmelin 2018). Already during the proposal stage, we built a consortium of 32 partners with experience and competency in co-creation and open urban innovation, as key drivers towards being able to develop Positive Energy Districts and Cities.

Our approach was to achieve local energy transitions by viewing and examining various municipalities, as well as research, industry, and citizens aspects, using a quadruple helix innovation approach (Carayannis and Campbell 2009). This ensures that cities' and citizens' needs are front and center, that solutions can be integrated across city domains, and research and industry can support the transition.

One key element to support this integration was setting up innovation testbeds in the city. These living labs (ENOLL 2020) facilitate experimental research in a real-world setting. The experiments are planned, implemented and monitored by a cooperation of public and private sector partners, academia, citizens and other stakeholders. The outcomes can be new or improved services, data, technologies or processes. Shared value can be created when the stakeholders – professional ones as well as citizens – organize themselves into open innovation ecosystems (Curley and Salmelin 2018). In the +CityxChange project, such ecosystems, called 'Innovation Playgrounds' (Mee and Crowe 2020), facilitate the development of new solutions and processes through physical, digital, and social support.

Mee and Crowe (2020) explain the difference between an Innovation Playground and an Innovation Lab. The former is a dedicated area in the city which provides a testbed and experimental environment open for citizens and stakeholders to pilot innovations in de-regulated conditions. The latter is the physical manifestation, comparably to urban labs or fab labs/makerspace, which provides a space to hold workshops, inform, engage, share, test, collaborate and co-create. The Innovation Labs provide an exchange point between stakeholders and give citizens a space to learn, ask, and experiment themselves. Furthermore, they serve as a physical and conceptual environment of the Citizen Observatory, which enables the distributed collection of scientifically verifiable data by citizens to contribute to transparent local decision making and policy development.

To create the enabling open innovation environment, our project focuses on three crucial dimensions. The first is the social dimension – the people or next-generation citizens who must be a part of co-creating and visioning and who must participate actively for the transition to succeed. Secondly, the technological dimension is essential, for example, encompassing a novel e-Mobil-

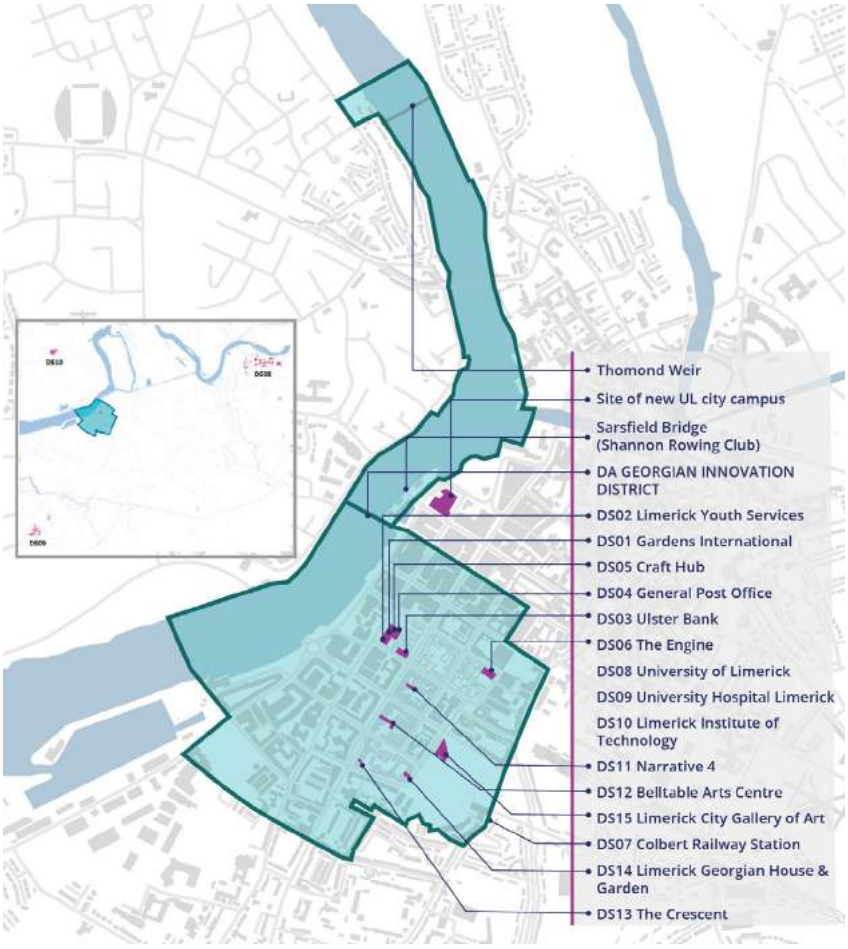


Figure 3: Project demonstration area and sites in Limerick, Ireland

ity as a service scheme or a local peer-to-peer approach for energy trading. The final key ingredient is establishing an environment of innovation through policies, regulations, as well as business models. While many more elements could be listed, these three should be the starting point, and everything else should be built upon as well as aligned with these as much as possible.

Smart city initiatives must emphasize co-creation and open innovation through active citizen engagement and participation to be successful in the long term (García and Mora 2020). In the past, and even today, many smart city approaches primarily focused on new technologies and view people only as users. However, active 'next-generation smart citizens' are critical to ensure the alignment of technological innovation with society's interests, to scale the work outside the projects, and instigate behavioral change. Therefore, strengthening the collaboration between the public and private sector, our primary focus is on citizen involvement. However, genuine participation that does not only 'tick the boxes' is challenging, resulting in the creation of an integrated system of different frameworks and concepts which are jointly working towards a citizen-led process.

How do we get people interested in and contributing to the project? We follow two specific approaches. First, Local Energy Champions are identified, trained and supported by the municipalities and project partners to distribute

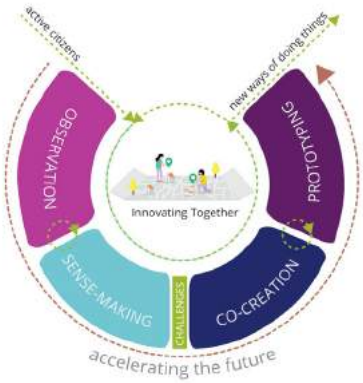


Figure 4: Innovation Playground journey

	Engage	Design	Activate	Accelerate	Support
Standardisation	Evaluation	Visualisation	Simulation	Funding	Sharing
Policy development	Review	Revision	Planning	Budgeting	Analysis
Innovation partnerships	Appointment	Linking	Collaborating	Prioritising	Portfolio management
Organisational development	Identification	Leadership	Intrapreneurship	Self organisation	Twinning
Citizen engagement	Acknowledgement	Deliberation	Localisation	Connection	Amplification
Project development	Pitching	Prototyping	Delivering	Capitalising	Storytelling

BOLD CITY VISION FRAMEWORK FOR 2050

Figure 5: Bold City Vision Framework for 2050

knowledge, advocate for change, activate residents – acting both as 'voice' for the project and representative of the community. Second, Next Generation Smart Citizens are guided to enable and ensure long-term, sustainable societal transformation, for example, through campaigns at schools and educational facilities and gamification of concepts and technologies.

Establishing the places and enabling stakeholders is essential, but eventually, the generated knowledge must be injected into the work of public and private stakeholders. Additional to the ongoing exchange in the Citizen Observatories, Innovation Labs and Playgrounds, the broader public is involved through concrete activities such as Climathons as well as Citizen Engagement Weeks. These activities link the project work with ongoing activities in the city and guarantee broad support of society while embedding it into ongoing project work. The results and learnings of these activities are continuously fed into the cities' Bold City Visions for 2050. They create a shared vision and strategy, aligned with other local, national and European Union policies, as well as global goals such as the SDGs or New Urban Agenda (Tanum et al. 2019). This mainstreaming ensures that all departments are working jointly towards a politically backed goal as well as providing an overarching vision document which guides other plans and policies beyond the project duration.

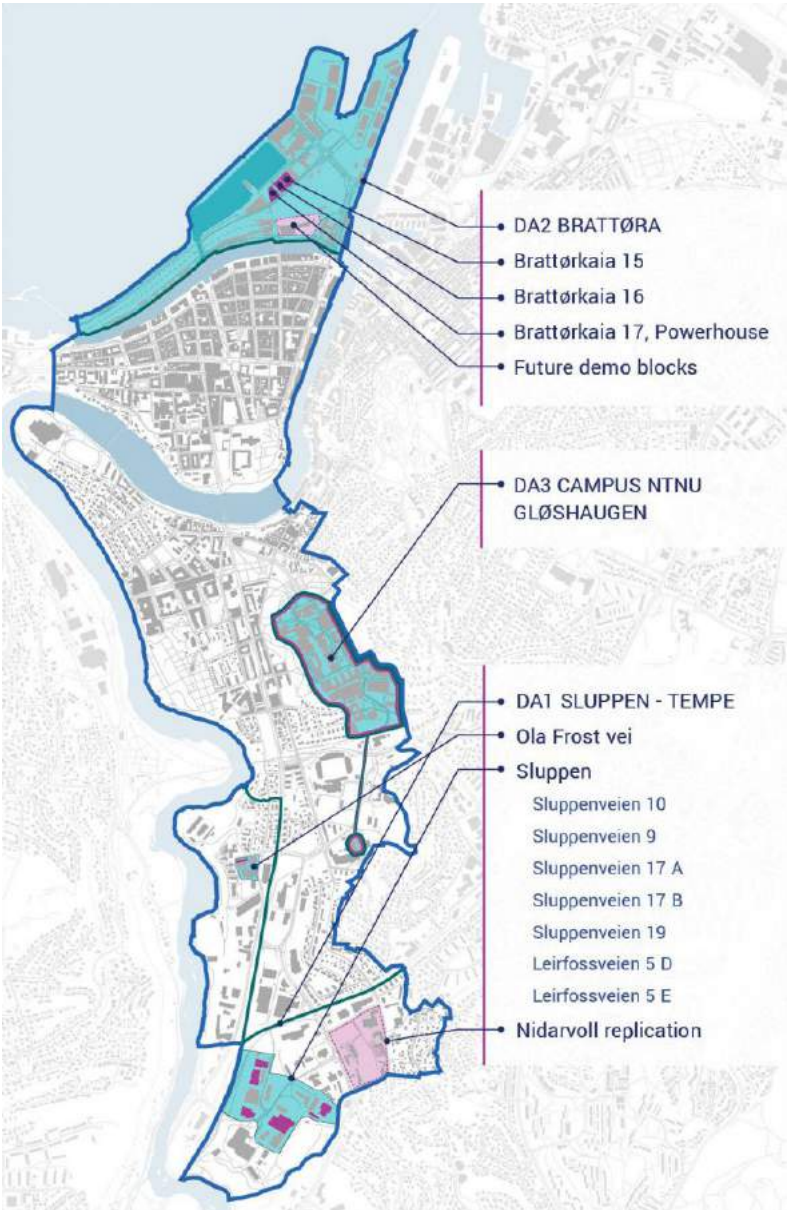


Figure 6: Project demonstration area and sites in Trondheim, Norway

FROM THEORY TO PRACTICE

The developed concepts are being translated and localized into actions within all seven project cities. We give a brief overview of the implemented actions so far in the two Lighthouse Cities.

Trondheim selected four physical spaces throughout the city to serve as Innovation Playgrounds for citizen engagement. The first one was set up at the municipal administrative offices. Here, public outreach and co-creation are co-located with a shared project office for the project and a number of other related city initiatives called *Innovasjonstorget*, including the University-City co-operation and the United Nations Centre of Excellence on SDG City Transition in Trondheim.

Figure 7: Official opening of the Powerhouse in Trondheim, a plus energy building and an anchor building in the project, owned by Entra, an associated partner, and designed by Snøhetta

Figure 8: Storytelling workshop in Innovation Lab Limerick

Figure 9: Climathon 2019 in Trondheim, Norway

Figure 10: Gamification. City Energy Game, Limerick's 2019 CityEngage Week

In Limerick a previously existing Fab Lab has been repurposed as an Innovation Lab which hosts regular events between the citizens, public and private sector. The University of Limerick operates the lab and currently plans the relocation and enlargement of the space together with other stakeholders of Limerick. This allows even more and diverse activities to take place while becoming a prominent public front of the positive energy movement.

At this Limerick innovation lab, a learning framework for Positive Energy Champions and Next-Generation Smart Citizen is in development and currently being tested. The learning framework consists of a 20 weeks period with a range of events, including the city engagement weeks, training, workshops, Climathons, and more. The latter is initiated by collaborating with schoolteachers from Smolyan and the University of Limerick, collaboratively setting up a learning environment in times of online education due to the COVID-19 pandemic.

The framework for the Bold City Vision 2050 resulted in a variety of visioning workshops as well as a scaling effect in Norway with other cities taking over the approach. Additionally, the generated knowledge is exchanged with the newly established United Nations Centre for Excellence in Trondheim which works towards the localized assessment of the Sustainable Development Goal achievement as well as the U4SCC[2] indicators (Tanum et al. 2019).

Mainstreaming the project activities into ongoing work of the municipal administrations and anchoring it within the community is crucial to ensure the project's success, as well as to scale from Positive Energy Blocks to Cities over time and after the completion of the project.

Innovative Technology in Positive Energy Blocks and Districts

The technical core of the +CityxChange concept for Positive Energy Blocks and Districts revolves around developing and upgrading paths and toolboxes for different aspects that can be adapted to different cities. It contains systems for local trading of energy, the integration of local storage, the integration of electric vehicles and their use, integrating energy and mobility needs and markets, sustainable investments into refurbishments and new buildings, tools for modeling, urban planning, and operations, an underlying ICT layer that integrated city systems and open data portals, and a pathway of how to include these aspects.

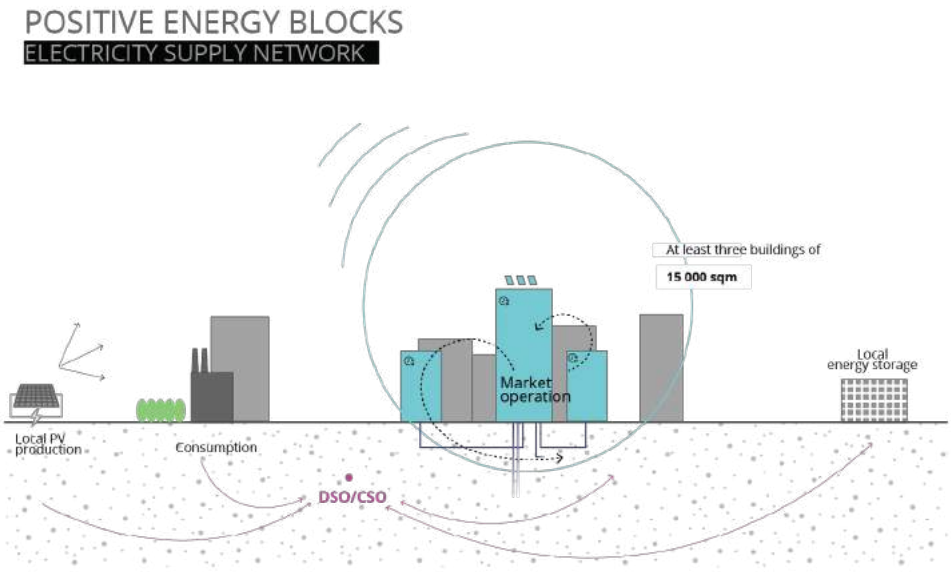
Spatially, a Positive Energy Block consists of at least three buildings, with a combination of old and new buildings in close proximity (with a minimum viable size) where concepts can be demonstrated. While it is possible to reach a Positive Energy Blocks with only new state-of-the-art buildings, such a development would not demonstrate how to integrate existing building stock to actually reach the energy goals within short timelines. Buildings of a zero or plus energy standard can serve as anchor buildings, enabling a Positive Energy Block together with their neighbors. As part of the urban concept, Positive Energy Blocks can be scaled up by plugging additional buildings, energy assets, and other measures into the system, allowing a growth path with increased local energy production and reduction measures, to grow towards a Positive Energy District.

To reach a net zero or positive block or district, not all buildings need to contribute equally. For example, for some older buildings full upgrades are not feasible, and the concept includes balancing between different types of buildings with different demand profiles, for example business and residential, coupled with short-term storage.

To bring the demand side down, building upgrades and refurbishments are needed along with changed energy behavior. On the other side, local generation in the form of photovoltaics, heat pumps, wind or water turbines raise the local supply and allow customers to move into prosumer roles. In addition, local storage in the form of electrical batteries is included, while the district heating system in small areas can be its own buffer, and some advanced buildings already have their own storage tanks to disconnect from the grid on demand.

A key component to connect energy and mobility needs is the inclusion of electromobility as a service, connected to the Positive Energy Blocks. This is a twofold contribution. The first aspect is an integration of people's mobility needs of electric car sharing, public transport, city bikes, etc. The second aspect is to use the energy from the residential or the work areas of the Positive Energy Blocks to charge the electric vehicles needed for this scheme. To make electric vehicles first class assets in the energy system, we pilot vehicle-to-grid technology. Instead of only optimizing the charging of electric vehicles, this enables the batteries of the electric vehicles to be used as storage for the Positive Energy Blocks. Despite rising electric vehicle use and shared car ownership there is a lot of downtime on these cars. Vehicle-to-grid technology utilizes car batteries, when the car is not being driven, to reduce overall needed stationary battery capacity.

All this is tied together with a local grid control system that integrates these assets as a local or community grid or as part of a larger grid. The grid control system actively manages these resources, enables peer-to-peer trading between buildings in a prosumer-enabled system, facilitates a flexible market for local grid operators, and aims to enable local data verification and market settlements through next-generation zero-fee blockchain systems.



Electricity supply network
of Positive Energy Blocks

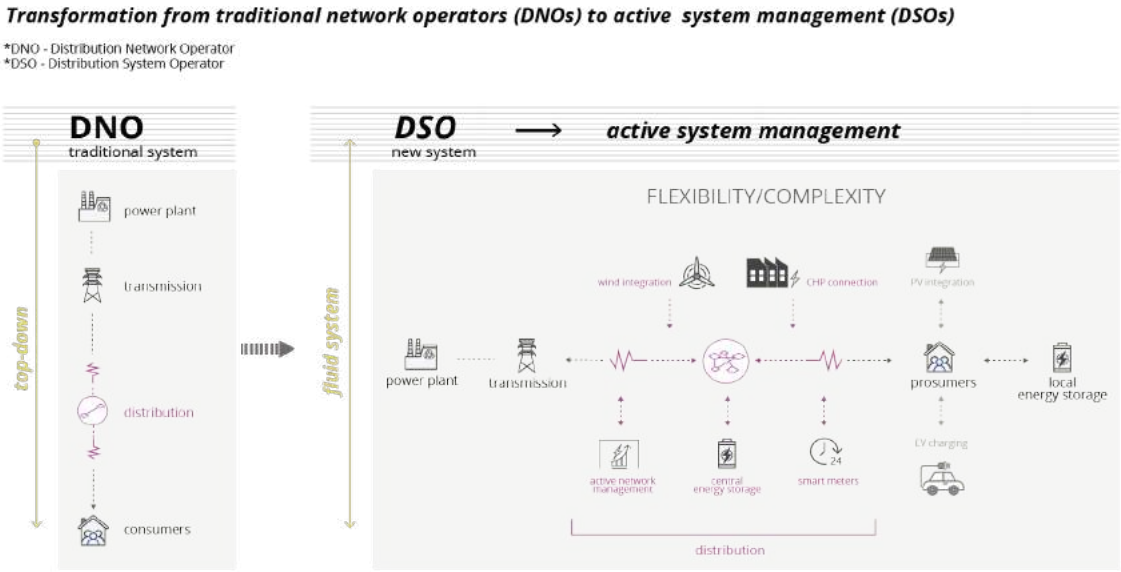


Figure 11: Transformation from traditional distribution network operators (DNOs) to active system management

In the current project phase, first smart meters and control systems are deployed and vehicle-to-grid chargers and batteries are being finalized. Various Positive Energy Block modeling and operating tools and decision support tools are in final development or testing stages. Market and flexibility models are developed and are being adapted for local implementation. Building owners are well integrated into the Positive Energy Blocks and investment models and replication are well underway.

Regulatory Frameworks and Investment Models

The development of Positive Energy Blocks or Districts needs to happen within the local/national regulatory boundaries. At the level of the European Union, the Electricity Regulation and Electricity Directive set the basis for flexible and connected markets whilst the Intelligent Transport System (ITS) directive (2010/40/EU) regulates the deployment of intelligent transport systems. However, the definition of the requirements related to these directives is delegated to the single nations, making the international scenario fragmented.

Smart cities innovations challenge the status quo and therefore require changes to existing regulations and financing models to support demonstration activities and piloting. To avoid regulations as bottleneck for the development, collaboration with regulators is therefore crucial. Single dispensations or dedicated permissions can be requested for specific requirements. This can make it possible to foster innovation and conduct live experiments in a controlled environment (European Commission 2018) through the Regulatory Sandbox framework (also called Regulatory Innovation Zones).

The purpose of a Regulatory Sandbox is twofold: to enable prototyping, testing and piloting of new technologies and approaches and to develop new guidelines and increase regulatory clarity in collaboration with the regulators.

The heterogeneous approach of each country does not allow the development of a turnkey solution. Disaggregated energy markets and industries limit the development of approaches easily replicable cross-country. Alignment between regulation and technology would lead to the development of new business models. Investments are required for the development of Positive Energy Blocks and sourcing financial resources is critical to the success functioning and implementation of a sustainable business model. Alongside national and local funding sources, innovative business models can include new funds and players that will work alongside traditional ones like crowdfunding and green bonds, small and medium-sized enterprises, technologies providers, energy service companies.

The +CityxChange approach is to develop an integrated investment model which can be adapted to different socio-economic contexts for the identification of a bespoke mix of financial products. In the models developed for the lighthouse cities the public authorities maintain a central role in the investment model supported by public private partnership and private investors, including building residents and commercial activities within the pilot sites.

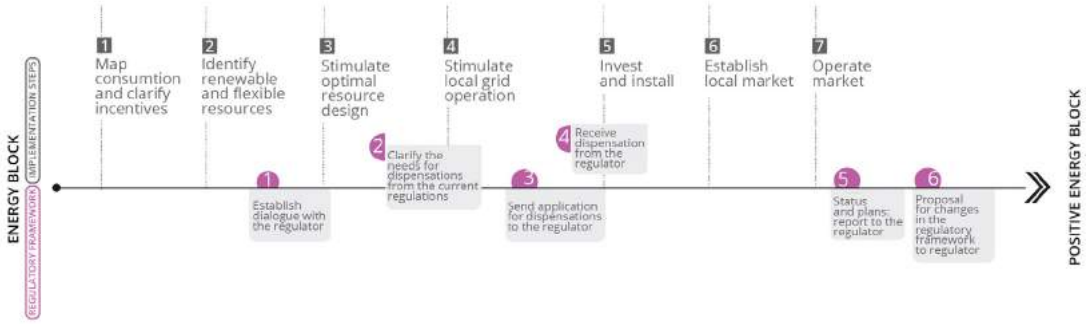


Figure 12: The +CityxChange regulatory sandbox approach

LESSONS LEARNED

Although replication is one of the aims of the European Commission Horizon 2020 Smart City program and it is encouraged within the projects, achieving it has been compared to the quest for the Holy Grail (Vandevyvere 2018). The combination of parties, interests, technologies, business models, legal context, social aspects, etc. requires a fine balance of different elements that can be hard to achieve.

In +CityxChange the lessons learned by the lighthouse cities in the first implementation phase are used to start the replication process in the follower cities. These lessons and the experiences in follower cities in turn are used to facilitate replication across at least 20 European cities. Since every environment and city is different, we do not offer a cookbook, but rather guidance documents and processes that support adaptation.

A replicable starting point is the creation of the Bold City Vision, combining existing city planning and management processes with goals, key opportunities and actions for becoming a smarter and more sustainable city. A clear vision, aligned with the existing conditions and developed in collaboration with stakeholders and not simply imposed, has proved to be the first step towards successful implementation for the lighthouse cities. Moreover, stakeholder engagement should not be considered a check-box exercise but instead should continue as their support is a discriminating factor for successful implementation of the solutions/innovations.

To enable and achieve change there has to be commitment from all levels. To promote success in the communities, the activation of citizens through, for example, Positive Energy Champions[3] is critical. It is also important to have a point of contact for the project who liaises with all the parties involved and promotes the change message linked with the implementation.

The adoption of open innovation as a guiding principle (Wyckmans et al. 2019) enabled: balanced individual concrete budgeting; risk management and investments with social innovation; shared value creation and the long-term, high-impact mission of contributing to positive energy cities; and, ultimately a climate-neutral Europe (European Commission 2020). After 18 months, this principle has also proven valuable to make room for the sometimes serendipitous (Mazzucato 2013) contributions of citizens, alternative processes, new technologies or opportunities for cooperation within a detailed, 5-year Description of Action.

To identify and document new learnings, dedicated learning sessions are organized between partners, to discuss and compare experiences from various cities, and then feed them back into the project for improved activities. While not originally planned for, the project is now developing metrics that are able to monitor the impact of these learning effects within the project and with others.

+CityxChange has a wide, targeted range of interactions with other projects and networks, both within Europe and beyond. In addition to dedicated cooperation with the other 16 Smart City Lighthouse projects, +CityxChange engages in cooperation with the members of the European Innovation Partnership (EIP SCC 2020) on Smart Cities and Communities to promote learning and replication, with the European Strategic Energy Technology Plan Action 3.2 (European Commission 2018a) Smart Cities and Communities in order to contribute to the creation of 100 Positive Energy Districts by 2025, and with the research organizations of the Joint Programme on Smart Cities of the European Energy Research Alliance (EERA JPSC 2020), to create a strategic research agenda able to support the development of positive energy cities and communities.

THE WAY FORWARD

Positive-energy cities that generate more energy than they consume, with net zero greenhouse gas emissions and a surplus production of renewable energy, can become the batteries of a climate-neutral society. However, this is not simply a technological question. Ensuring that such cities are, first and foremost, sustainable, resilient, safe and inclusive, as well as positive-energy, requires robust open innovation ecosystems of small, medium and large companies, public sector, academia, citizens, the arts, cultural and creative industries, media, non-for-profit foundations, and many more. For these stakeholders to cooperate, requires a solid framework – a safe space – in which they can come together, discuss, test, fail, try again and eventually find good solutions for their local environment. As such, the +CityxChange project aims to be the bridge that helps experts and citizens to come together and innovate.

We hope to join forces with similar projects across the world, to be able to expand the cooperation to other countries and regions and learn how the project's experiences may help transform existing urban environments in China, India, or Africa, into positive-energy cities and communities. We also look forward to what we can learn from them.

Acknowledgements

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Endnotes

1 For more information, see https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/lc-sc3-scc-1-2018-2019-2020 and https://smartcities-infosystem.eu/scc-lighthouse-projects.

2 United for Smart Cities and Communities (U4SCC) is an initiative by ITU and UNECE and supported by several UN agencies. It is a global platform to strengthen the use of ICT in the transition towards smart sustainable cities. https://www.itu.int/en/ITU-T/ssc/united/

3 individual participants who will incorporate the positive energy concepts into their daily life and promote it by encouraging and helping fellow citizens to do the same.

4 The full consortium and more information on the project are available at https://cityxchange.eu/team

Figure 13: Project representatives during project meeting in 2019

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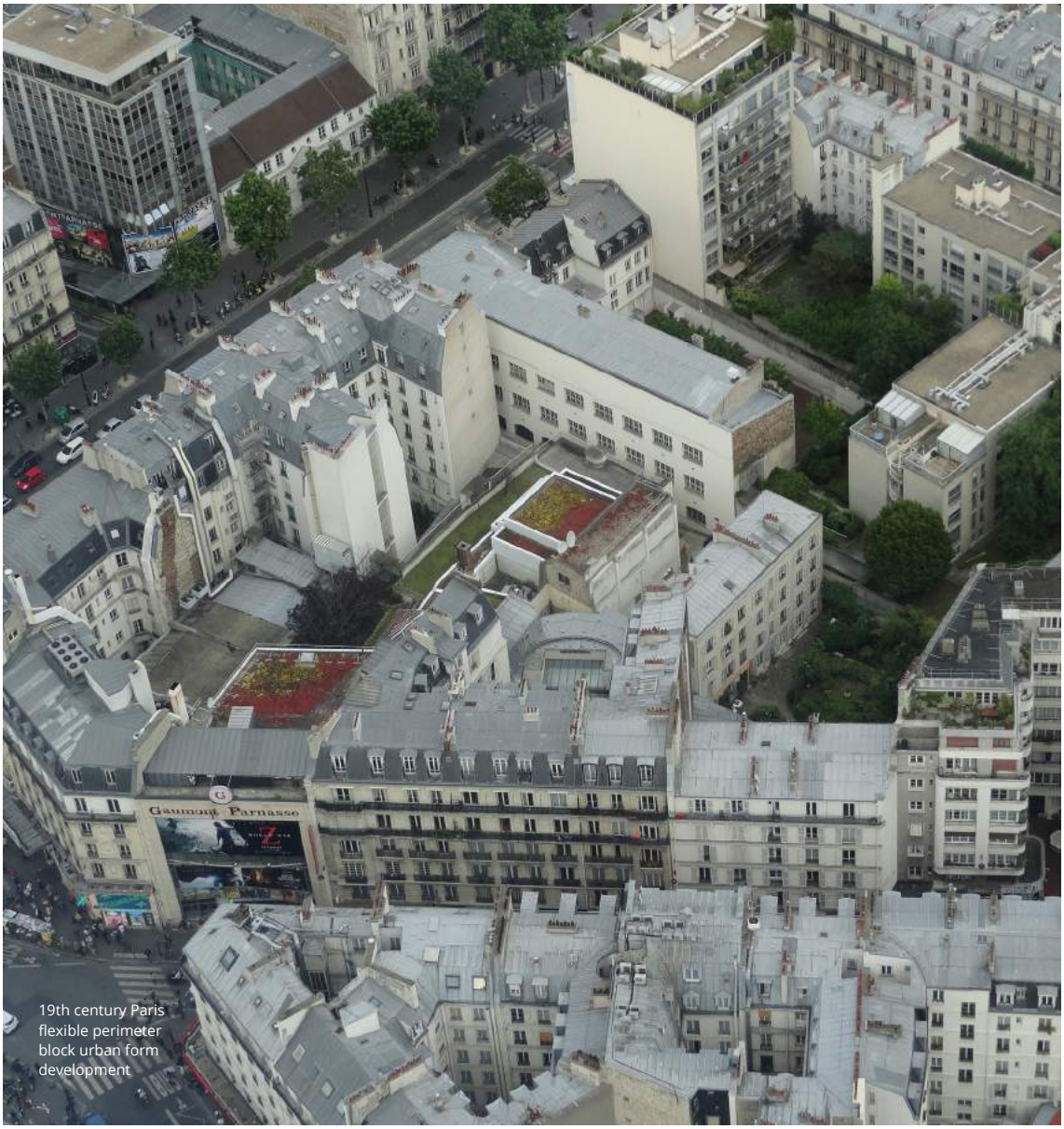
NO ENTRY

Sustainable Urban Forms in an Oil-Constrained Future: An Australian City Context

Roger J. Brewster



19th century Paris flexible perimeter block urban form development

It is generally accepted that modern cities are 'the products of the development of fossil fuel technologies'[1] and that oil has become fundamental to every facet of modern civilization. For example, Droege contends that 'it is difficult to overstate the significance of black gold in defining virtually everything that cities are today: spatially, economically and culturally'[2].

But as oil becomes scarcer, cities will need to adapt[3]. This article forms a theoretical framework for strategies towards a post-oil city. It reports that oil depletion creates opportunities for transformation to a more sustainable, resilient urban development pattern[4]. Such regenerative cities also produce significant benefits for climate change mitigation with less dependency on oil technology. Newman et al. framed it in terms of *Resilient Cities* in responding to peak oil and climate change.[5]

This article assumes a sustainable development (SD) framework. It embraces many disciplines that address the architectural, environmental, economic and social aspects of development, including the concepts of urban metabolism and sustainability science[6]. SD is not an endpoint, but an integrated dynamic process of adaptation, learning and action—including inter-generational aspects—of the socio-economic system that embraces the concepts of land use planning[7]. The latter is illustrated in the initial conceptual Oil-related urban metabolism model (see Figure 1).

In the context of this model, the elements of metabolic processes[8] central to producing urban residential stock include land, building materials and infrastructure components, including energy flows[9]. The case studies of building-embodied energy[10], using material flow analysis[11] and extensive grounded theory research[12], provide insights about how land use planning could assist the transformation of urban residential forms towards an oil-constrained future[13].

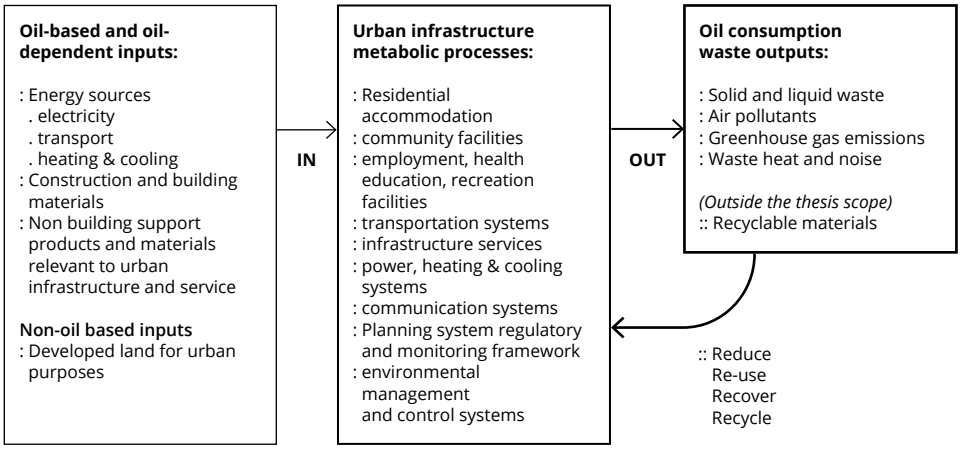


Figure 1: Initial oil-related urban metabolism model. Source: Adapted from Yencken and Williamson (2000: 130-36)

IN SEARCH OF THE OIL-CONSTRAINED CITY

An investigation of older city areas (of the 1800s era) as well as some modern ones, was conducted in Europe, North America, and Asia. In addition, twelve Western European cities, acknowledged as having 'sustainable' and 'smart city' features, were evaluated. This information was used to create a practical integrated strategic framework to provide a policy basis for adjustments to land use planning systems.

The 'sustainable' features of the cities are shown in Figure 2. They are consistent with urban design qualities noted by Lynch in his seminal book *Good City Form* [14].He proposed that a 'good city' is vital, sensible, well fitted, accessible, well controlled, and achieves justice and internal efficiency. He also noted characteristics that make it safe, structured and legible having a form that is adaptable; having accessibility that is diverse and equitable; and having control systems that are responsive and appropriate to the circumstances. More generally it is a continuous, well connected, open place, conducive to development[15].

The initial categorizing resulting from analyzing observations of the pre-oil economy cities is summarized across each row in Table 1. The data was first based on a range of contextual details; secondly allocated to planning related concepts; then assigned to generalized groups – noted below – as planning and environmental themes with an abbreviation for coding brevity. Each theme has inter-relationships and influences on other groups, which are noted in the table. The data was also objectively ranked (1 is most important) in order of significance to sustainable development of these cities. The eight coding groups used in this study were:

1 Socio-economic hierarchy of the city – extending to regional scale (SEH)
2 Urban morphology or *city form* noted above at the city-wide scale (UMor)
3 Urban structure as a precinct scale unit (USU)
4 Design qualities of the Urban fabric (UDes)
5 Urban metabolism as noted above (UMet)
6 Mobility and transportation system factors (Mob-trans)
7 Energy metabolic flows in and out of the city (Energy-flows)
8 Geographic and climatic underlying factors (Geo).

The ranking of relationships on a qualitative significance scale 1 (high) to 5 (low) is based on modified urban development under conditions of constrained petroleum supply, with smart city policies; coupled with *mitigated* climate change. The overall first ranking of the USU and UDes groups are the most important. Rankings may change as oil depletion accelerates to make the UMet factors more important as the embodied energy and transport related factors of building materials and petrochemicals increase in priority. Existing and new public transport systems and electrification of vehicles will offset the deteriorating oil supply situation for private transport. If future oil constraints result in decreased CO_2 emissions and serve to mitigate climate change, the component of the Geo factor will have improved to a fourth-place ranking.

An underlying assumption for the study was that the 1800s style building would be modernized with the later advantages of electricity, technological inventions of electric lifts (elevators) and self-lifting cranes. It also assumed that significant advances were being made in materials science, including non-petroleum-based plastics. Hence it was important to keep these factors in mind while observing sustainable and adaptable features in the urban morphology of pre-oil economy cities, which might be relevant to a transformed city in an oil-constrained future.

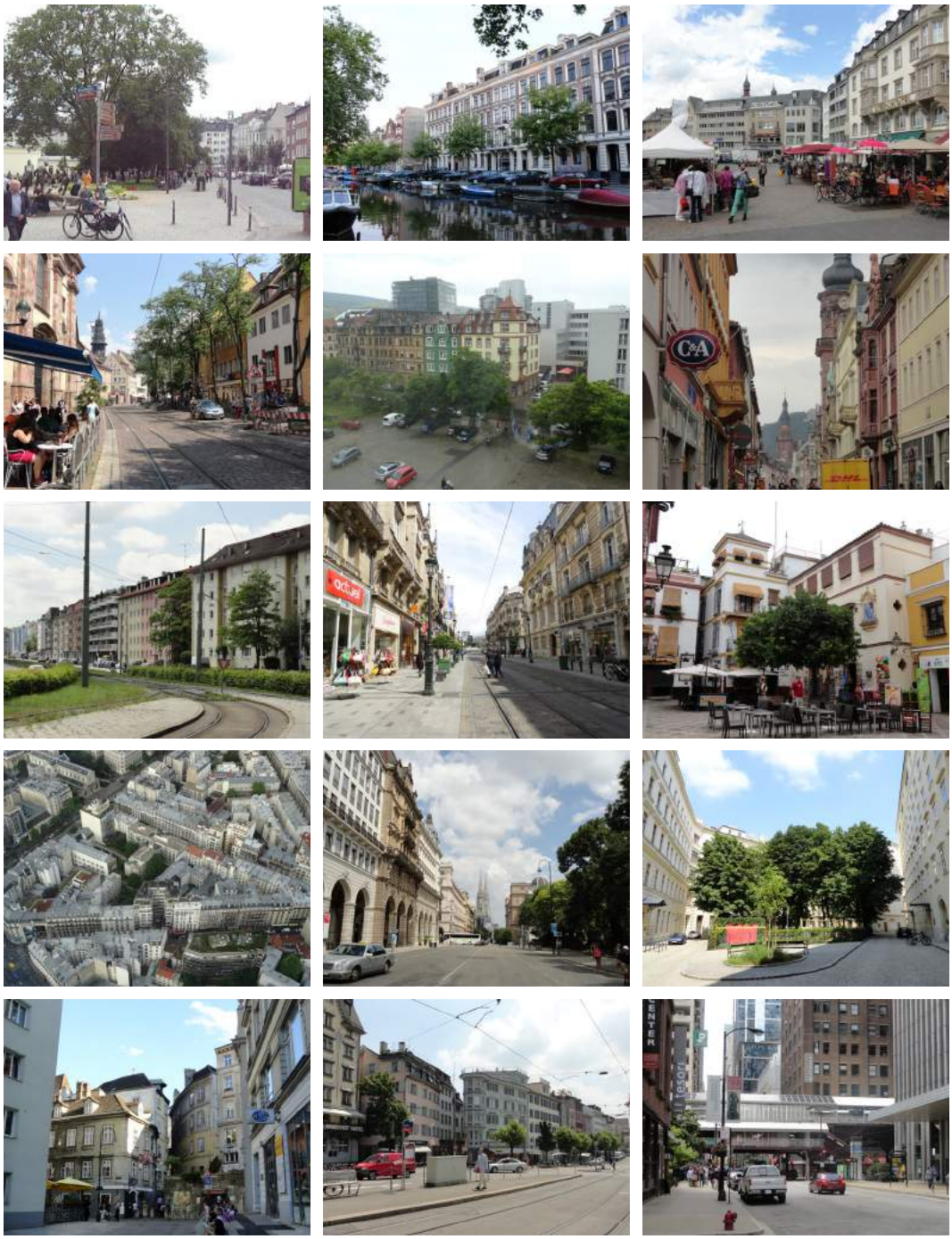


Figure 2: Some common sustainability features of the selected cities

Data summary	Concepts	Group	Relationships	Rank*
Politico-economic functions of the city in its region & country	Urban hierarchy scale and city size	Socio-economic hierarchy (SEH)	SEH influences the UMor & investment	1
Historical development of city: focal centre or multi-centric	Urban transects – simple or complex	Urban morphology end result (UMor)	UMor integrates USUs, UDes, UMet	2
Street pattern: grid, concentric, monumental, haphazard, alleys	Urban form spatial structures/patterns	Urban structural unit (USU) framework	USUs relate to UDes, UMet within UMor and influence Mob-trans & Energy-flows	1
Streets, plazas, parks: places to move through & socialise in	Urban public realm, social interaction	Urban structural unit (USU) framework		
Block size: short less than 100 metres with building continuity	Built environment and street interface	Urban fabric and design (UDes)	UDes influences and develops USUs and relates to Mob-trans by integrating public transport and the pedestrian network. UDes also influences Energy-flows in the efficient siting and design of buildings	1
Walkable streets, direction finding, focal and end points	Mobility and legibility of spatial structure	Urban fabric and design (UDes)		
Building types: commercial, residential, public, churches, monumental, landmarks	Urban fabric typology for mixed uses and apartment living	Urban fabric and design (UDes)		
Building heights: low 1-3 storeys, medium 4-8 storeys, high > 8 storeys	Urban fabric scales: dense inner urban development	Urban fabric and design (UDes)		
Building materials and sources, road/plaza sealing and paving surface materials	Building/construction technology, resource conservation	Urban metabolism (UMet): building flows and stocks	UMet relates to USUs and UMor as the variables in UDes, Mob-trans and Energy-flows that determine the urban flows and stocks	2
Energy efficiency in buildings: - Embodied energy - operational energy - Heating and cooling methods	Building energy technology and conservation	Urban metabolism (UMet): building related energy flows		2
Transport evolution: pre-oil, traffic free areas, electric trams, traffic management, private car or public transport dominant	Transport technology and public-private investment policies	Mobility and transport system factors (Mob-trans)	Mob-trans relates to UDes and influences USUs; and critically depends on Energy-flows. Types of public transport are determined by the urban public policies & investments. Mob- trans is also inter-urban & international	3
Public transport types: trams, light rail underground, heavy rail, electric trolley buses, fossil fuel powered buses	Transport systems and networks and public investment policies	Mobility and transport system factors (Mob-trans)		3
Traffic hierarchy: prime vehicle access, shared pedestrian-vehicular traffic, pedestrian	Movement & mobility hierarchies: can put cars or people first	Mobility and transport system factors (Mob-trans)		5
Energy for light and power: conventional, renewables	Stationary energy technology	Energy metabolism flows (Energy-flows)	Energy-flows depend on energy resources available to the city & renewables (e.g. PV)	4
Energy for transport: fossil fuels, renewable sources	Transport energy technology	Energy metabolism flows (Energy-flows)		3
Water connection: riverine or coastal topography & location	Geographic/climatic context: e.g. for design & renewable energy	Geographic and climatic factors (Geo)	Geo influences UDes, UMet, Energy-flows & UMor of the city	3
Climatic context of city				4

*Group codes: Socio-economic hierarchy (SEH), Urban morphology city-wide result (UMor), Urban structural unit- precinct scale (USU), Urban fabric & design (UDes), Urban metabolism (UMet), Mobility & transport system factors (Mob-trans), Energy metabolism flows (Energy-flows), Geographic & climatic factors (Geo) * Rank in significance – 1 is most important*

Table 1: Categorization of sustainability concepts

Of course, the pre-oil economy cities themselves have evolved in the use of renewable energy, modern technology and transport, so they provide examples of more or less successful transition to the future. Several of the cities analyzed are involved in European sustainable city and smart city movements including the European Sustainable Cities Movement[16], European Smart Cities initiative[17] and more broadly the ICLEI-Local Governments for Sustainability[18].

QUALITIES OF OIL-CONSTRAINED SUSTAINABLE CITIES

The next stage of research conceptualized desirable qualities of oil-constrained sustainable cities. Given the goal is to progress towards an oil-constrained scenario, the analysis of the cities was framed around the following questions to form a theoretical basis for adaptive strategies:

A How might the urban fabric and form reduce dependence on oil?
B What features of these cities contribute to an efficient urban metabolism?
C Overlaying these aspects, how do these cities perform in providing suitable housing, facilitate mobility of people and transport of food and goods, to promote social and commercial intercourse?

Urban fabric and housing that reduces oil dependence

In many of the older cities there is a remarkable consistency in the residential buildings. Paris is an exemplary city (see Figure 2), having a notable uniformity in the apartment building facades and heights that creates harmonious streetscapes.[19] This effect was largely the result of building regulations of 1783-4 and later amendments in the comprehensive 1859 building code under Baron Haussmann. The later effectively allowed up to six stories to the cornice, with one-two attic levels (often for servants) in a mansard roof. Such blocks also incorporate light wells or courtyards to improve ventilation in the apartments.

Similar joined up street facades can be seen in other European cities including the Vienna Ringstrasse, German city centers including Aachen, Bonn and Heidelberg. It is also a feature of southern cities such as Florence in Italy, Barcelona and Seville in Spain. In Amsterdam the style of building is different and individual residential buildings have narrower frontages, but the overall effect of joined up street facades is prevalent along the canals and streets (see Figure 2). In most European studied cities, it was evident that the perimeter block apartment complex is a climatically adaptable design, which facilitates an active street frontage for commercial and retail uses mixed with the residential function where appropriate. This building form may also have flexible communal internal open space and extensive green roofs with solar PV arrays.

In newer cities slab blocks replaced the perimeter block as parallel blocks with inter-building garden and parking space, which can be problematic by being relatively underused and unsafe. The modern Vauban Quarter of Freiburg-im-Breisgau, Germany has a variation on this design where the ground floor units at the street end of the oblong apartment blocks have a flexible arrangement and sheltered overhang to facilitate active space (Figure 3). In contrast, an enormous PassivHaus project at Bahnstadt, Heidelberg[20] was planned using parallel blocks combined with traditional interrupted perimeter block urban design without active ground floor commercial spaces, as shown in Figure 4.

The relevance to an oil-constrained environment is that they are compact cities where land is used more efficiently, and the gross urban density of the building fabric is increased. In many cities the squares and plazas form the public meeting and eating places as well as open space elements featuring trees, monuments and fountains. They add legibility and diversity to the city fabric, as do community and public buildings in plazas. The urban form of

Figure 3a: Apartment buildings in Vauban Quartier of Freiburg im Breisgau

3b PassivHaus apartments Bahnstadt, Heidelberg

Figure 4: Heidelberg Bahnstadt model (source: photos by author)

Figure 5: Greenwich Millennium Village, London

Figure 6: 2007 master plan of Greenwich Millennium Village, London

A. Detached house
B. Low rise apartments
C. Medium rise apartments
D. High rise apartment tower (30 storeys)

Figure 7
Representative residential building typology

Figure 8: Typical case C three-bedroom comparison apartment 183.5 m2 GFA

these cities is not geared around cars, rather as walkable precincts.

A residential tower above a commercial podium could also have an active street frontage. However, the medium rise/high density Paris style block is considered to be more economical and flexible and requires less concrete and hence less embodied energy in its construction. Such buildings are more flexible in use, because the whole frontage is not constrained to be commercialized as in a podium arrangement. Balconies or garden rooms can either face the street for more surveillance, and/or face the rear garden-courtyard areas. Elongated or joined up buildings can provide the backdrop to a 'green' street and may also incorporate green walls and green roofs as in the Paris examples. Such buildings also facilitate rooftop solar PV for local power generation. Other advantages of medium rise (4-8 stories) buildings include opportunities for large scale modular and off-site component manufacture and the use of structural timber to replace steel reinforced concrete; which is impracticable in a high-rise tower.

While these features may seemingly have little to do with oil dependency or depletion, they are important factors in creating an inner urban form conducive to a car-free, oil-free lifestyle.

Greenwich Millennium Village in London is designed as a walkable urban village of 1800 dwelling units linked by buses to the nearby underground station. The photos at Figure 5 show the style of the 5-9 story northern buildings, which enclose a large courtyard garden space. The 2007 master plan at Figure 7 shows the familiar pattern of urban residential form at the block scale as in pre-oil economy cities with medium rise/high density apartments and an open perimeter block layout; some buildings having activated ground floor mixed uses[21] (Countryside Properties PLC 2013).

Urban built forms for efficient urban metabolism

While the theoretical concept of urban metabolism was introduced in the late twentieth century, resource constraints of building materials have existed since ancient times (Register 2006). The urban metabolism as such, was framed around 'primitive' technologies in the material inputs, with minimal waste or polluting substances, apart from the end products of wood and later coal burning. Efficient use and recycling would be common, because of the cost of extracting, refining and making anything in terms of both technology and labor. The so-called 'alternative' natural building materials used in modern 'eco-housing' often reflect the vernacular construction of primitive societies, medieval and pre-oil economy cities (Roaf 2007: 330-457).

A case study comparing four building types was undertaken to analyze embodied energy in residential construction in terms of conventional building practices in the Australian context[22] using a sample of typical buildings indicated in Figure 7.

From an embodied energy viewpoint, the analysis found that detached houses are the most energy efficient form and can involve the least complicated construction processes. However, other analysis of low density, detached housing estates reported an inefficient use of land, which requires more roads and engineering services, and results in perpetrating suburban sprawl. The next most energy efficient building form was a 6-story apartment building based on a typical 3-bedroom apartment (Figure 8) for cross comparison with other cases. Table 2 illustrates the process of analyzing the building components for embodied energy using available database coefficients[23]. The summary analysis table for the 6-story case at Table 3 shows the result of that process. The least efficient forms were a 3/4-story apartment building with ground level parking

in the same complex, and a 30-story high-rise apartment building, partly because of 3-level basement parking. The case study findings in Table 4 indicate the benefit of medium rise apartment buildings based on embodied energy as the key factor and taking into account the size of dwelling units.

The results of the case studies are graphed in Figures 9 & 10. In terms of occupancy, note that two rates are used: a 'typical' value and a 'statistical' value. The typical value is suggested as a 'design' occupancy based on the likely ultimate whole person number. The "statistical" value refers to the census averaged occupancy in similar development along Australia's Gold Coast City[24]:

A The 3-bedroom plus study house represents a family home for two parents and two children, totaling four persons. A larger number of children could be used, but the statistical evidence does not support it as the Gold Coast statistical suburban average household size is only 2.8 and the Coomera largest remaining greenfield development district since the 1990s is 3.0 (Gold Coast City 2013).

B The 2-bedroom low rise apartment represents an inner urban style home for a couple, or two share mates. The average Gold Coast statistical rate is 1.85 per unit for inner suburbs.

C The 3-bedroom apartment represents a home for a couple and with either one child or a share-mate study;; or three share-mates. More occupants are not justified by the statistical averages, which are 1.7 per unit in inner suburbs, however, a value of 2.1 per unit is used.

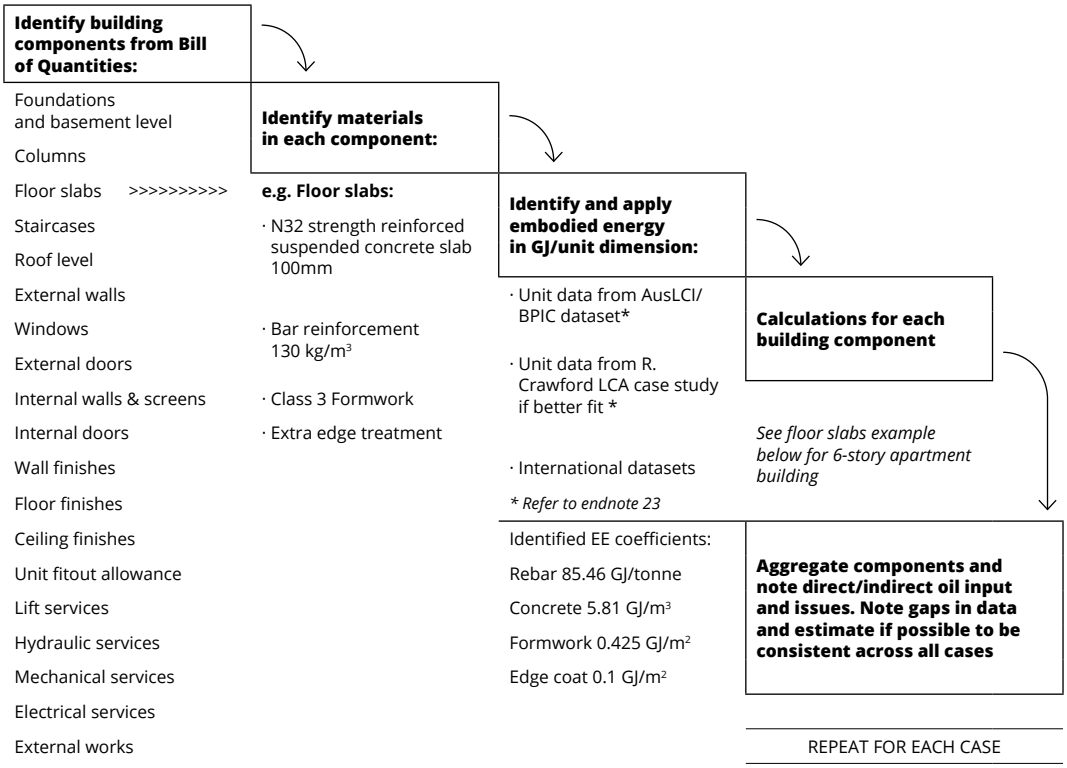
D The 2-bedroom high rise apartment represents a central urban style home for an even mix of singles and couples (or two share mates). Hence the rate is set between one and two persons at 1.5. The statistical average value in the coastal strip is 1.3 per unit.

The graph of energy intensity indices in Figure 10 suggests clear relationships between building types, but actually it disguises complex comparisons. The first (blue) series gives the impression that there is a very narrow spread in energy intensity per m^2 of GFA between all building types, which in itself indicates all the commercial scale buildings have relatively similar building fabric25 (apart from parking basements). It displays variations of up to 18 per cent occur between the 6 story building and the other cases. However, energy intensity per m^2 of GFA is a deceptive measure, because it does not take into account the numbers of bedrooms in each comparison dwelling, or the occupancy rates. The other series, focusing on these variables show a much greater variation above the detached dwelling base case. Interestingly the low-rise and high-rise building cases that compare 2-bedroom units with the 4-bedroom house are respectively nearly three and two times the energy intensity value per bedroom. This result is reinforced in the series comparing typical and statistical occupants. The variability within each case is due to differences in typical and statistical occupancy rates.

The case study analysis points to a tentative conclusion that detached housing is the most energy efficient building form, while acknowledging it is an inefficient use of land. Medium-rise residential buildings are the preferred compromise for a more land- and energy-efficient form of development in terms of embodied energy, offering house-size apartments. When construction energy data is combined with the compact urban form effects on urban metabolism of urban planning design (USU and UDes groups), emulating medium-rise perimeter urban block form of 19th century Paris, Vienna and elsewhere demonstrates an alternative pathway to a sustainable future that is more in tune with an oil-constrained scenario. Modern examples include the

super-efficient PassivHaus project at Bahnstadt in Heidelberg shown in Figure 4 and the Greenwich Millennium Village shown in Figures 5 and 6. Both projects are designed as medium-rise high density perimeter urban block forms for more efficient urban metabolism.

Worked example of the case study embodied energy analysis process



Level	Component description	Quantity m3	LCI Rate GJ/m3	Embodied energy GJ	Oil related input	Gaps in data
Ground	Suspended concrete slab, 1734 m2	434,0	5,81	2 521,5	Indirect	No
1	Suspended concrete slab, 1538 m2	385,0	5,81	2 236,9	Indirect	No
2	Suspended concrete slab, 1538 m2	385,0	5,81	2 236,9	Indirect	No
3	Suspended concrete slab, 1538 m2	385,0	5,81	2 236,9	Indirect	No
4	Suspended concrete slab, 1544 m2	386,0	5,81	2 242,7	Indirect	No
5	Suspended concrete slab, 1466 m2	367,0	5,81	2 132,3	Indirect	No
	Bar reinforcement - 130 kg/m3	304.0 t	85.46/tonne	25979,8	Indirect	No
	Class 3 Formwork m2	10653,0	0.425 GJ/m2	4527,5	Indirect	No
	Extra edge coat treatment - m2	546,0	0.1 GJ/m2	54,6	Indirect	No
Floor slabs component total embodied energy in 6-story building				**44169,0**		

Table 2: Worked example of the case study embodied energy analysis process

6-story medium density apartments - 45 Units - 1 Basement modified for analysis

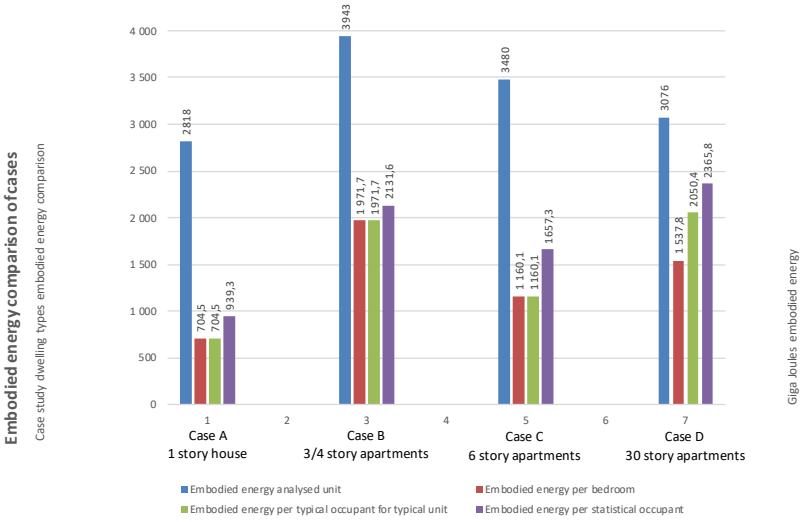
Building components *materials only*	**Embodied energy GJ**	**Complete?**	**Main omissions**
Foundations and basement level	10 550	N	Sheet piling
Columns	15 405	Y	
Floor slabs	44 169	Y	
Staircases	1 509	N	Aluminum handrails
Roof level	4 696	N	Gutters, downpipes, plumbing
External walls	6 806	N	Aluminum handrails, balustrades
Windows	11 028	Y	
External doors	52	N	Entry security gates
Internal walls and screens	12 482	Y	
Internal doors	3 144	Y	
Wall finishes	335	Y	
Floor finishes	1 350	Y	
Ceiling finishes	388	Y	
Unit fitout materials	22 553	Y	
Hydraulic services	5 648	N	PVC piping for plumbing services
Mechanical services not available	-	N/A	Basem't ventilation, trash chutes
Electrical services	14 002	N	Allowed 200 GJ per unit in all cases
Lift services not available	-	N/A	Similar omission for all cases
Site preparation materials not available	-	N/A	Site preparation highly variable
External - adjoining 150m roadworks	1 086	Y	Includes Bitumen road, concrete paths
Total embodied energy for materials	**155 204 GJ**		Note: omissions were generally consistent across all cases
Embodied energy of comparison 3 bedrm unit: 3480 GJ			**Unit area 247 m² total GFA**

Table 3 (top): Embodied energy for case C apartment building as modified for analysis

Table 4 (next page): Case study types - comparison of recorded embodied energy

Case study residential building types: comparison of recorded estimated embodied energy

Building Type	No of storeys	Total dwelling units as analysed	Total bed-rooms	Equiv. bedrooms; design and statistical occupants in typical unit	Average internal unit area m2 GFA	Total dwelling area including balconies plus parking m2 GFA	Total building area m2 GFA	Total building embodied energy GJ	Total building embodied energy per m2 GFA	Total embodied energy per typical unit GJ	Total embodied energy per typical unit bedroom GJ	Total embodied energy per typical unit 'design' occupant GJ	Total embodied energy per typical unit statis-tical occupant GJ
Detached house	1	1	4	4 - 4 - 3.0	132	185,0	185	2 818	15,2	2 818	704,5	704,5	939,3
Low rise medium density apartment building	3 over ground level parking	15	32	3 - 2 - 1.85	130	"162.3+75.4 = 237.7"	3 770	62 540	16,6	3 943	1 971,7	1 971,7	2 131,6
Medium rise medium density apartment building	6 with 1 basement	45	128	3 - 3 - 2.1	122	"183.5+63.5 = 247.0"	11 016	155 204	14,1	3 480	1 160,1	1 160,1	1 657,3
High rise, high density apartment tower	30 equiv. with 3 basements	172	228	2 - 1.5 - 1.3	Varies - 'typical' unit is 112	1-bed = 64 1+1 bed = 88 2-bed = 124 Plus 63 parking	28 302	466 961	16,5	3 076	1 537,8	2 050,4	2 365,8



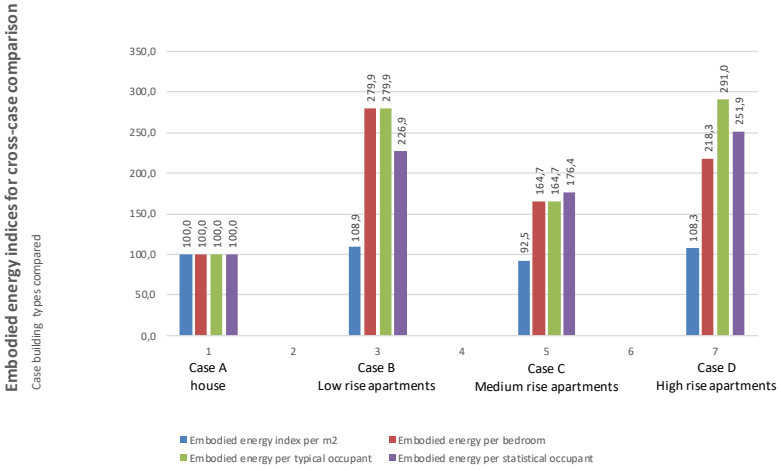


Figure 9 (top): Embodied energy results for cross-case comparison

Figure 10(bottom): Embodied energy indices for cross-case comparison

Mobility, transport and function in sustainable cities

The electrified light rail, underground and bus-based public transportation systems that evolved from the 1800s, and embedded in the urban fabric, are an important consideration in the efficient functioning of old central city areas (*altstadt* in Germanic countries) and their newer inner and outer suburbs. The systems in most of the old cities analyzed generally converge on or near the main rail station, which links the city to the extensive regional, national and international rail networks.

In polycentric metropolitan regions, the transport systems are necessarily more diffuse to handle the volume of passengers. European examples include London, Milan, Munich, Paris and Vienna, all of which have multiple mainline stations and efficient underground metro and surface light rail systems. Many other global cities have similar systems. The fact that they are all electrified future-proofs the cities with respect to passenger transport. Vienna *altstadt* has a fleet of all-electric buses operating since July 2013, which complements the metro and *Ringstrasse* tram routes to navigate the narrow streets and can recharge from overhead tram lines.

Other cities have compressed natural gas powered or electric-hybrid buses as an alternative energy source. Zurich has S-Bahn, trams, buses and electric trolley buses in a closely integrated system stretching into the outer suburbs. Apart from the integration of public transport modes, mobility in the old city centers is greatly facilitated by the proximity of living accommodation, working and shopping facilities. Traffic congestion is managed in different ways—in some cities by taxing (e.g. Transport for London[26]); in others by low speed controls, parking restrictions, or environmental regulation (Zurich and Munich). Since October 2008, Munich has a low emission zone to control access into the city center.

A radically different approach to congestion management is simply to allow it to occur and act as a strong disincentive to using private transport in the inner city. Cities such as Amsterdam; Barcelona; Aachen, Bonn and Heidelberg *altstadt* in Germany; Leicester in UK; Montmartre and Orléans in France; and Zurich in Switzerland have extensive shared traffic-pedestrian zones with limited or no on-street parking (Figure 2). These streets and plazas are pleasant places to be in and walk through. Personal mobility in these places was assessed by Gehl to be such that the new urbanism target of a five-minute walking zone could be doubled with little sense of inconvenience[27]. Combining this local mobility with timetable-free public transport for arrival and departure in the central area promotes a car-free lifestyle, enhanced by using the bike sharing service provided in many cities. The same could not be said about walking in the big modern North American cities, because of the large block sizes, traffic congestion and lack of restful public plazas or parks. Downtown Portland is an interesting exception, because small block sizes of about 60–100 m square in Figure 11 are a deliberate design feature to encourage walking at one minute per block with enhanced permeability in the city center.

In his analysis of what makes cities sustainable, Gehl acknowledges the depletion of fossil fuels, and energy consumption and emissions of buildings as important issues. He focuses on transport as a key element and advocates higher priority on pedestrian and bicycle traffic 'to change the profile of the transport sector' (Gehl op. cit. p.105) as in Amsterdam (Figure 12). He also advocates more compact and transport oriented development (TOD), expressing the view that 'before the incursion of cars, old cities were all well-functioning TOD cities'; and that 'a good city landscape and good transportation system are two sides of the same coin' (Gehl op. cit. pp.105, 107). The points being





Figure 11 (top): Portland Oregon small blocks and plazas facilitate walking and resting, aided by the tram system

Figure 12 (bottom): Amsterdam - a city landscape conducive to social intercourse and good active transportation system

highlighted are that the urban form of pre-oil economy cities offers relevant solutions in providing the foundation for a sustainable city that is adaptable to new active transport modes.

The Australian National Urban Policy (NUP) also considers that 'alternative urban development forms can significantly influence transport energy use and greenhouse gas emissions ... Modelling of land-use scenarios for Melbourne illustrate the long-term benefits of a compact inner city and a small number of larger polycentric outer cities in achieving urban sustainability outcomes'[28]. The difference in perspective of this study compared with the above NUP statement is the likely impact of oil constraints on urban form—rather than just transport costs and CO_2 emissions—which leads to the synthesis of desirable characteristics of an oil-constrained city. The NUP was updated and complemented by the Smart Cities Plan in 2016.[29]

CHARACTERISTICS OF OIL-CONSTRAINED SUSTAINABLE CITIES

The result of the grounded theory coding process is the emergence of six groups as sub-categories, and a core category described as *sustainable urban form* as an amalgam of the top ranking urban structural unit and the urban design groups (from detailed coding tables not presented in this summary)[30]. In the coding of efficient urban metabolism there are four key themes considered to have regional or national significance: technological innovation and inventions; national targets for renewable energy; setting energy efficiency standards; and food security policies. These themes need to be taken into account in the application to post-oil cities. The groups are matched to a compressed set of 18 thematic relationships in Table 5 plus nine omitted secondary transport related themes that align with the author's definition of sustainable urban form.

Table 5 indicates a strong validation in terms of the proportion of themes

with a consolidated 'high' relevance to the sub-category groups. However, caution is needed in interpreting the three-point ordinal scale, because it is not a comparison of like with like between the themes. Hence the temptation to make statistical inferences has to be avoided. Aside from that caution, the themes indicate that mobility and transport, closely followed by urban fabric and design, and energy metabolic flows, are the most significant relationships; then follow the urban structural units and urban metabolism because of low impact of underground rail systems on USU and UMet (not shown in this table).

The author's definition of urban form to describe the physical entity of an urban area (A-C) also describes the additional properties (D) of a sustainable urban form as a set of complex relationships comprising:

Table 5: Selectively coded categories and relevance to six significant groups of urban development themes and legend

DATA — Relevance to six Groups***** (Table 1): H = high; M = moderate; L = low

Summary of themes	**USU (precincts)**	**UDes**	**UMet**	**Mob-trans**	**Energy-flows**	**Geo-climate**
National renewable energy targets	H	H	H	H	H	H
Diverse mixed-use cities	H	H	H	H	H	H
Compact, dense development	H	H	H	H	H	M
Reduced city ecological footprint; regenerative urban ecology/farming/ high-rise f arms/ community gardens	H	H	H	H	H	H
Productive hinterlands support city population and increase food security	M	M	H	H	H	H
Vernacular architecture in residential building design and materials to conserve resources and promote off-site production/manufacture	H	H	H	H	H	H
Technological innovation/inventions including building materials	H	H	H	H	H	M
Cultural acceptance of transformation in urban design and construction	H	H	H	H	H	L
Perimeter block apartments in medium rise 4-8 storeys height range	H	H	H	H	H	L
Residential towers in suitable locations	H	H	H	H	H	L
Limit new low density development, but detached houses as an efficient energy form in suitable locations	H	H	H	H	H	H
Comprehensive building codes to control design	H	H	H	H	H	H
Energy efficient buildings with light wells/courtyards, green roofs/walls as appropriate, including high insulation standards (e.g. PassivHaus) for low energy consumption	H	H	H	M	H	H
Continuous street façades, with active frontages and harmonious streetscape; small block sizes	H	H	M	H	M	M
Green street design with tree planting and a hierarchy of road widths with cars limited in narrow streets	H	H	H	H	H	M
Plazas with seating, interesting art and fountain features, trees, which create spaces to meet and add to the legibility of cities	H	H	H	H	M	M
Low energy mobility and extended walking radius to 10 min./1 km	H	H	H	H	H	M
Transit oriented development focus	H	H	H	H	H	H
Relevance criteria subtotals H/M/L	**17/1/0**	**17/1/0**	**17/1/0**	**17/1/0**	**16/2/0**	**9/6/3**

* ***Groups: USU*** *(Urban structural unit-precinct scale),* ***UDes*** *(Urban fabric and design),* ***UMet*** *(Urban metabolism),* ***Mob-trans*** *(Mobility/transport system factors),* ***Energy-flows*** *(Energy flows),* ***Geo*** *(Geographic/climatic factors)*

A the framework of urban structural units in a hierarchy of scales, transformed within the emerging historical, geographical, ecological and climatic context;
B the urban design—shape, height, density and appearance—of the built environment, including the interface between the built environment and public realm—streets and public spaces, public and private open greenspace;
C mobility and movement hierarchies—networks and transport systems; and
D the urban metabolism supporting, facilitating and sustaining the socio-economic functionality of a city, including social and cultural processes, metabolic flows of substances, goods, energy and communication within a regenerative ecological footprint.

A schematic model of the completed grounded theory process is adapted from Gray 2009[31]. Figure 13 shows the relationships between a sustainable urban form and the code groups in the context of an oil-constrained scenario. The causal condition is oil depletion, which could be modified by those properties and dimensions affecting the sustainable urban form phenomenon to produce a desired outcome analogous to an oil-constrained sustainable urban form. Of course, undesirable outcomes are also possible but not shown in the model, which would result in unsustainable urban forms.

FOUR GROUNDED THEORIES AND STRATEGIES FOR OIL-CONSTRAINED CITIES

Four theories were developed and verified from the research to offer insight, enhance understanding, and provide a guide to planning-related action on oil depletion. They succinctly explain the effects that probable future oil constraints may have on urban residential development, and hence their relationship to the planning of urban forms in the context of a twentieth century city, applied in an Australian coastal setting.

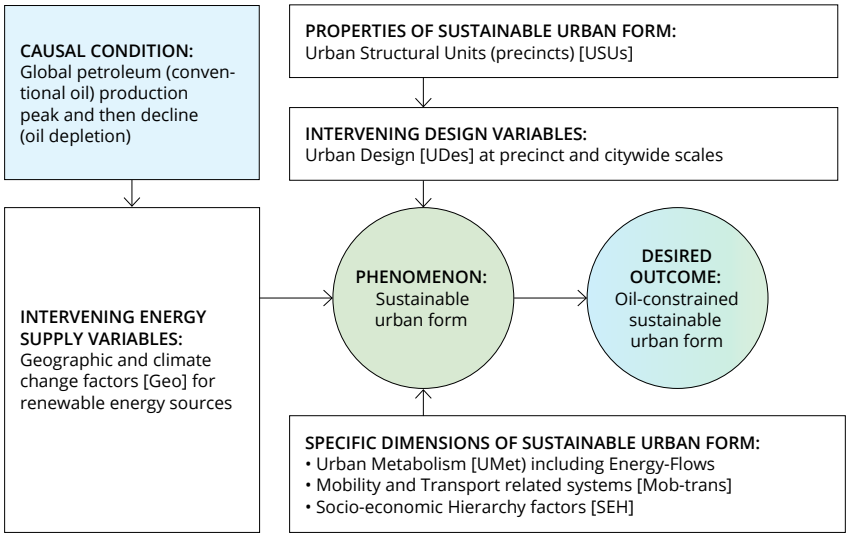


Figure 13: Schematic model of relationships between oil depletion and a desired oil-constrained sustainable urban form outcome

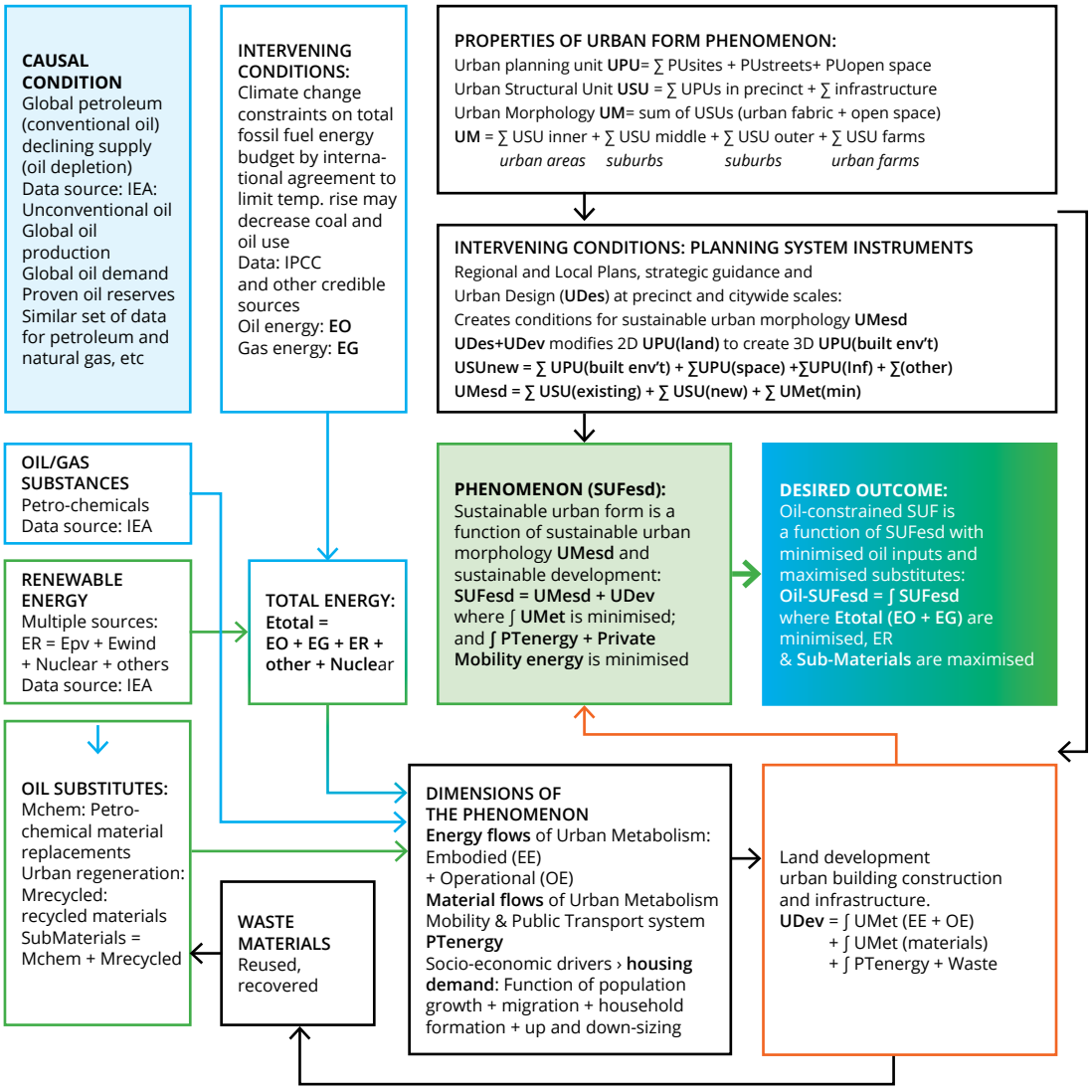
1 ***Oil depletion gradually affects all types of urban residential buildings at site scale:***
Oil supply constraints will gradually affect the sustainability of all new land development and construction for all types of urban residential buildings to varying extents, depending on the materials used and transport-related factors. Materials-related vulnerability may be reduced by adoption of non-petroleum substitutes. Transport-related vulnerability may be reduced by conversion of diesel-powered construction vehicles and machinery to replacement 'fuels' as a mitigation setting. They are also relevant in a global setting.

2 ***Adaptive design is needed for sustainable urban residential form at precinct scale:***
Adaptive urban design for oil-constrained sustainable urban residential forms at precinct scale is facilitated most efficiently medium-rise/high density apartment buildings arranged as perimeter/courtyard blocks—in relation to achieving objectives for building material and energy flows, urban density, adaptable functionality, streetscape and public-active mobility-oriented development.

3 ***Oil depletion will increasingly affect urban communities at middle-outer city scales:***
The oil depletion transport-related mitigation phase increasingly inhibits suburban sprawl-led city-wide expansion and accelerates redevelopment pressure in inner urban serviced areas close to public transport. In the later adaptive phase, availability of system-wide alternative energy powered vehicles may mitigate mobility and living costs in more affordable housing in existing middle/outer areas.

4 ***Transformative planning system policies are essential at city and regional scales:***
As the phenomenon of oil depletion gains international acceptance as a wicked global problem, it will influence government urban land use policies at both city-wide and regional scales within the state and national planning system context. Transformative guidance on urban metabolic energy flows is linked to state and national policies on transport, renewable energy and climate change mitigation.
Detailed implementation of inner urban redevelopment to promote mixed use at higher densities would be subject to planning provisions to suit local conditions, including strategic guidance in oil depletion adaptation policies and land tenure.

The initial conceptual model in Figure 1 and the schematic model in Figure 13 were synthesized into an Integrated Strategic Framework. Figure 14 shows the complex set of relationships as the basis of policies to integrate the effects of oil constraints in an urban metabolism based framework for sustainable planning and development. Combined with the four underlying theories above and derived sustainable city characteristics below, this research forms a roadmap for strategic planning to transition in three phases towards an oil-constrained future. This roadmap would guide local planning authorities; however, it is critically dependent upon community acceptance and support for the radical paradigm shift to a post-oil city.



Legend: **SEH** *(Socio-economic hierarchy),* **UMor** *(Urban morphology city-wide result),* **USU** *(Urban structural unit-precinct scale),* **UDes** *(Urban fabric and design),* **UMet** *(Urban metabolism),* **Mob-trans** *(Mobility and transport system factors),* **Energy-flows** *(Energy metabolism flows),* **Geo** *(Geographic and climatic factors).*
*The desired outcome is Oil-constrained Sustainable Urban Form (***Oil-SUFesd***), which is a function of: {Sustainable Urban Form (***SUFesd***) where total energy (***Etotal***: oil and gas) is minimised; and renewable energy (***ER***) and oil-substitute materials (***SubMaterials***) are maximised}.*

Figure 14: Integrated strategic framework showing detailed qualitative relationships and legend

Characteristics of an oil-constrained sustainable city

The planning-related characteristics of a sustainable city under the scenario of oil constraints are distilled into a narrative about a desirable oil-constrained sustainable urban form arising from the research, case studies and grounded theory relationships:

A Urban development within well-defined boundaries facilitates densification and public transport, and outward expansion is curtailed by planning policies and public transport factors. The city-wide urban form is transformed to be compact and thus conducive to active (walking and cycling) mobility for everyday activities.

B The city has a comparatively reduced ecological footprint by the combination of regenerative urban and hinterland ecology, renewable resource cultivation, hinterland horticulture, urban community gardens and building based farming.

C Low density residential development is limited by planning policies, but detached houses are acknowledged as efficient energy forms in suitable locations, particularly in the outer suburban areas. This area is promoted as a productive urban living/horticulture zone, facilitated by transferrable development rights. The existing detached housing stock in the Australian context is considered adequate for family accommodation as young and older people prefer inner suburb living.

D Medium-rise/high-density buildings to be consistent with family size apartments are a preferred type of urban residential development as an alternative to detached houses. This alternative is strongly associated with a cultural acceptance of such an urban design form in European cities but may be resisted in the Australian and American context, unless planning and financing policies incentivize this residential form.

E Central and nodal activity centers are planned as integrated mixed use, three dimensional eco-architectural systems to fully exploit the residential opportunities in a range of medium-rise development. Residential towers are in suitable TOD locations, such as at focal points and in areas of existing towers. The strategy is implemented in cooperation with the private development sector and supported by public awareness community engagement programs. Piecemeal (re)development extending from the activity nodes is avoided where possible by infrastructure scheduling and local government coordinated site amalgamation and leasehold.

F Urban design for dense development features semi-continuous street façades in small street blocks with active frontages and harmonious streetscape. Green street design and a network of landscaped plazas with seating, attractive art and water features, creates pleasant spaces to meet and add to the legibility of cities. Such features promote walking and low energy assisted mobility (e-scooters and shared bikes) to extend the comfortable radius to 10-15 minutes or about 1 km.

G The entire city is serviced by multiple forms of public transport, including surface and underground systems that are tightly coordinated with high frequency operation. The land use–transport system is designed to transform effectively most of the city towards a public–active mobility-oriented development (P-AMOD) focus that promotes and realizes densification in ways that go beyond current TOD towards 20-30 minute everyday precincts focused more on ‘place’ than ‘transit’.

H Private car usage is reduced by constrained oil pricing and car sharing. Active transport is prioritized where practicable. Shared traffic-pedestrian zones are integrated with public and active transport routes in central and nodal centers.

I Comprehensive building codes support the innovative design of low embodied and operational energy-efficient buildings with high insulation standards (e.g. Passiv Haus where climatically effective) and star ratings. Technological innovation and inventions include non-oil-based building materials and construction methods.

J Vernacular architecture in residential building-design is promoted to use local materials, reduce cement consumption, conserve resources. Facilitating off-site manufacture of major components reduces the transport-related elements of construction and is integrated into the three-dimensional eco-architectural system.

K Renewable energy sources must gradually make the city independent of the oil-economy both in mining, manufacture of components and in operation of the built environment. This implies solar, wind, hydrogen (and nuclear?) power technology eventually is capable of constructing and maintaining locally distributed electrical systems. Innovation and invention in battery technology are increasingly important in the urban economy and in transportation. However, the weight penalties of battery packs make fuel cells more practicable in long distance transport vehicles. Energy density to power heavy duty construction and mining machinery (such as excavators) is problematic and will probably continue to rely on bio-diesel fuel.

L A transformed city suggests an overlay of energy and socio-economic related characteristics. While some of these qualities may not be directly planning related, they nevertheless need to be considered in the strategic planning transformation.

Strategic planning for oil depletion

Strategic planning for oil depletion is suggested in three phases:

- a mitigation phase of conserving oil supply and reducing demand;
- an adaptive 'transitional city of tomorrow'; and
- ultimately a transformed regenerative 'oil-constrained city of the future'.

The initial *mitigation phase* of oil supply decline will gradually see stepwise price increases for transport fuels as oil producing nations restrict exports. This will lead to prioritized rationing (or differential pricing) of petroleum products to extend the time horizon for the benefits of the finite resource to provide oil-based essential materials and the petrochemicals relied upon for building components and infrastructure construction, goods manufacturing, industrial transport systems, etc. That implies not wasting the long lead time opportunities during the oil decline period. Both industry and government take adaptive action with educated community support to invest in making new-technology vehicles of all types and develop the necessary distribution networks for both electric charging and hydrogen refueling for road and sea transport. Alternative vehicle manufacturing programs are already in progress. These programs will take a decade or more to develop and implement the innovative technology to transport goods and move people within and between cities.[32]

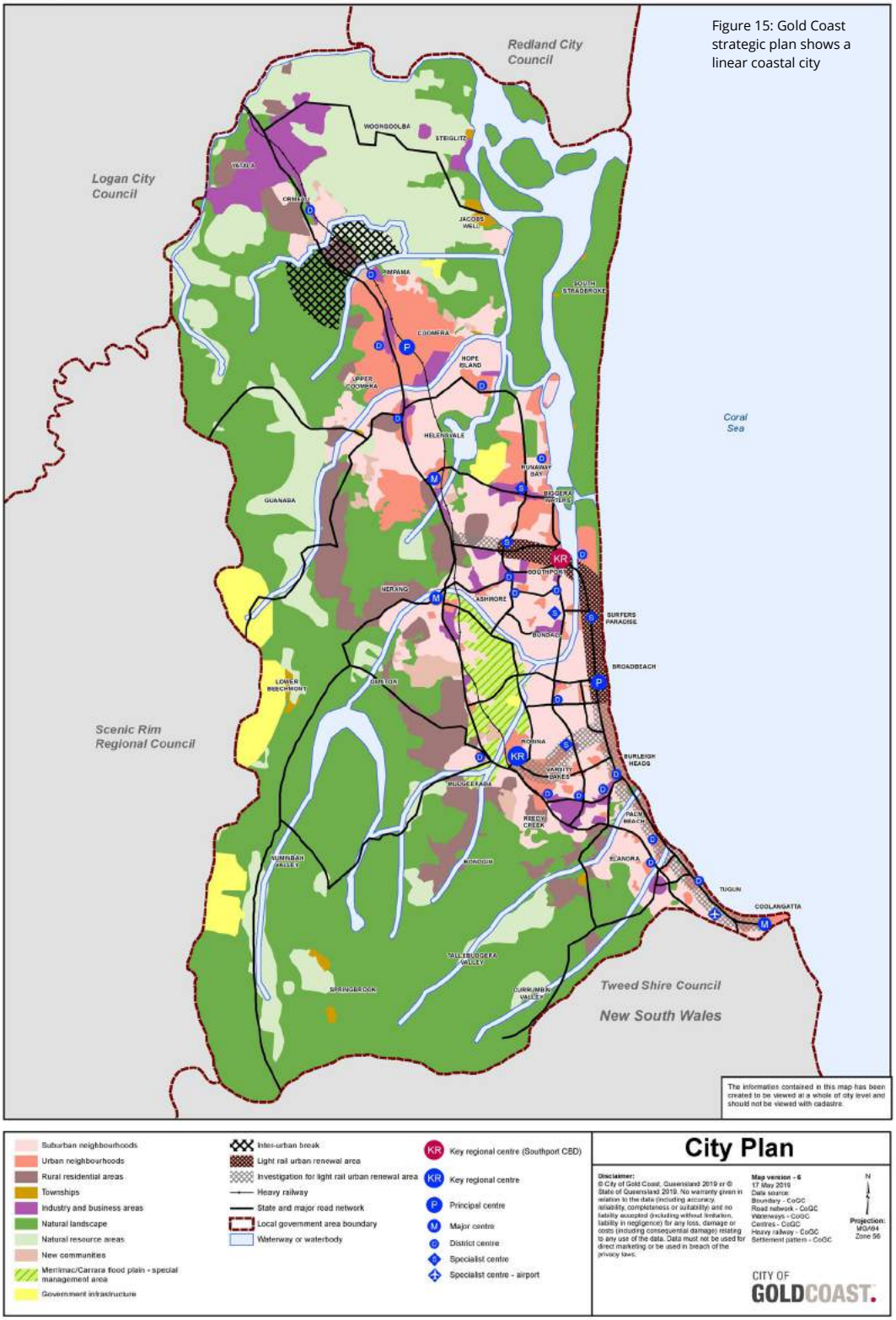


Figure 15: Gold Coast strategic plan shows a linear coastal city

Gold Coast City Plan and transport strategies	Comments on progress (refer to page 145)
City Plan Part 3 land use strategic framework	The intent to develop a world-class city is shaped over a 20 yr timeframe by the strategic framework to 2040
Objective: creating liveable places – limiting urban sprawl, developing new communities around sustainable transport, developing strong centres and TOD neighborhoods	
Urban activity is contained within the city's designated urban area boundaries: • Develop new greenfield communities around sustainable transport. Achieve a minimum dwelling yield of between 15 to 25 dwellings per net hectare	Progress toward characteristics A and C would limit growth to Coomera district. Reduced ecological footprint B is not being achieved by current policies. Progress toward D, E, F depends on private development facilitated by City Plan zone codes. Current plan uses the term 'transformation' in a limited sense to progress towards L as post-oil city.
Transformation of existing traditional urban centres and key inner-city neighborhoods: • By focusing on centres, the City Plan will support these places to mature into more vibrant and appealing urban places. Public areas will be safer and more attractive, and will be better designed for working, walking and living. • Greater flexibility will support centres as they grow into mixed use employment areas that facilitate economic growth and attract skilled workers and investment.	
Varied building height and form throughout the city reinforces local identity, creates a sense of place and supports well-designed adaptable housing choice and affordability: • Suburban neighborhood areas are maintained as predominantly low-intensity, low-rise detached housing residential environments that retain local character and amenity. • Changing housing needs will be in keeping with the existing scale, intensity, amenity and character of local areas, in particular their desired low-rise appearance	Outer suburbs have no strong strategies to become more compact to achieve C, because of the policy to retain existing character in low-rise detached housing residential areas. Modest efficiency gains may achieve I and J.
Medium and higher intensity housing occurs in mixed use centres and specialist centres and in urban neighborhoods that may vary from pockets of detached housing on smaller lots to medium or higher-intensity places containing medium or high-rise buildings.	D and F should be achieved by planned densification along light rail route renewal area and in centres over a long period.
Integrated transport strategies (Gold Coast Transport Strategy 2031)	Transport Strategy aims to achieve A, E (TOD), G (P-AMOD focus on place), H by low energy mobility active transport. Wider state and private enterprise action are needed to achieve K on energy. All centres above local scale could be TOD targets depending on market forces. In Southport light rail is a development catalyst to achieve P-AMOD status for the CBD area, but it is not being achieved in non-coastal suburban parts of the city.
Objective: To support well-designed urban development that reduces the need to travel and is easy to access via frequent public transport, walking and cycling: • Development intensity in the city's urban area will generally increase to align with improved public transport services and the augmentation of essential infrastructure networks. The city's integrated transport system will be the centrepiece of how to manage the city's growth, providing new transport choices, trends and patterns • Prioritise future urban development as 'transit-oriented development' (TOD) in centres and along public transport corridors. Plan for connected and autonomous vehicles • The light rail will be a catalyst to transform the city into a highly connected, compact city with vibrant centres, specialist precincts and urban renewal corridors	
Objective: To improve the quality of the public transport system to progressively deliver a city-wide, integrated, high-frequency public transport network, consisting of light rail, heavy rail and rapid bus as an attractive alternative to the car for everyday trips	Progress on G depends on more than system integration being implemented to make 20-30 minute everyday precincts.
Objective: To manage car parking in a way that supports the economic vitality of the city centres and boosts sustainable transport use; and transform carparking within centres	Carparking is relevant to car sharing and self-drive in H reducing private car usage
Objective: To protect land close to freight routes for use by freight-generating businesses	Relevant to off-site manufacture in J.

Table 6: Overview of Progress on Gold Coast City Plan and Transport Strategies

In the *adaptation phase* of oil depletion development of all new land and buildings is potentially affected until upscaled renewable power sources become available for a substantial replacement of the whole vehicle fleet, including conversion of diesel-powered commercial/industrial transport, machinery and equipment used to construct low embodied and operational energy-efficient buildings. Such adaptations apply to the whole chain of cradle-to-gate production of buildings, civil engineering materials and components. Well-integrated transformation strategies for battery/hydrogen 'fuels' and distribution systems are accelerated in conjunction with alternative aircraft fuels. The public transport system is fully developed, and light rail and bus routes are used to transport goods at nighttime to internal distribution points. Liquid and pneumatic pipeline systems move continuous supplies of substances and remove wastes.

In the *constrained phase* of oil depletion, organization of land use and movement of people, goods and materials requires complex reorganization of resources under the guidance of governments beyond points A - L above. Strategies implemented for renewable stationary energy and alternative motive power technology away from oil- and gas-based solutions restore energy security and establish the post-oil city.

APPLICATION TO EVOLVING GOLD COAST PLANNING STRATEGIES

The research into oil-constrained cities was applied to the lifestyle and tourist City of the Gold Coast in South East Queensland, which has evolved rapidly over the past 50 years from a linear string of small coastal settlements to the sixth largest city in Australia (Figure 15). It hosts more than 13 million tourists each year. In 1997 the Council had joined other cities in the International Council for Local Environmental Initiatives (ICLEI) for Climate Protection Program. Gold Coast planning in the past assumed globally unconstrained oil supply and climate change adaption generally aligned to state policies.[33] Ongoing research into the evolving 2016 City Plan policies follows progress being made toward transition to a more sustainable form of post-oil urban development.[34]

The City Plan represents a major shift from development on the city's fringe to redevelopment of urban centers and key inner-city neighborhoods to provide diverse lifestyle opportunities within inclusive communities. Population projections of 800,000 by 2031 indicate a need to develop a total of 130,000 new dwellings. About 80 per cent of dwellings are targeted through development or redevelopment within existing urban areas. Creating livable places in the multi-centered city is dependent on efficient transport.

The City Transport Strategy 2031[35] is guiding the integration of transportation with urban form to create a smart, connected and livable city. It notes that energy from all sources is likely to become more expensive in the future, because of the reduced supply of oil-based motor fuels as well as the *possible slowing of growth* in oil production. The rollout of stage 1 of a light rail system was a major milestone towards lower oil/gas-dependent public transport on key routes and stage 3A is in development in 2020. The city plan land use and transport strategies with comments on progress towards characteristics of a post-oil city are presented in Table 6 and conceptually in Figure 16.

Figure 16: Gold Coast City Plan Strategic Framework - illustration of the broad urban transformation strategy

CONCLUSIONS

My research into the phenomenon of oil depletion and strategic implications for urban residential development has taken a wide-ranging perspective of most disciplines associated with city making. The results have been summarized into four grounded theories and an integrated strategic framework to guide strategies for oil-constrained post-oil cities.

The grounded theories operate at different scales of the urban form, involving a sequential timing in their relevance and application:

1 Oil constraints gradually affect all types of urban residential buildings at site scale
2 Adaptive design is needed for sustainable urban residential forms at precinct scale
3 Oil depletion will increasingly affect urban communities at middle-outer city scales
4 Transformative planning policies are needed at city-wide and regional scales

Coincidentally the theories progress up the scale of urban form structural units from the building lot to precinct to city-wide to metropolitan region scale and beyond. These temporal and spatial scales suggest strategic planning will evolve in three phases:

› a mitigation post-peak oil phase of conserving oil supply and reducing demand;
› an adaptive phase of uncertain period to a 'transitional city of tomorrow'; and
› ultimately a transformed regenerative oil-constrained 'post-oil city of the future'.

While old European cities may be attractive from physical, environmental, social and aesthetic viewpoints, they are not a universally applicable recipe for western and Asian style cities devoid of that heritage—especially a twentieth-century lifestyle city like the City of Gold Coast in Australia that has a subtropical mild–hot climate. The suburbanized form is not at all like the compact old European cities and there may be no compelling reason to directly emulate those energy-efficient cities surveyed in this study. However, the research clearly demonstrates that the analyzed characteristics of a pre-oil-economy sustainable city are still very relevant to transformation into a post-oil city.

Endnotes

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2 Droege, P 2006, The renewable city: a comprehensive guide to an urban revolution, Wiley-Academy, Chichester, p. 160.

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4 Whipple, T 2020, The energy bulletin 30 March 2020, Post Carbon Institute, Corvallis, Oregon USA. Available at https://energybulletin.org/the-energy-bulletin-weekly-30-march-2020/

5 Newman, P, Beatley, T & Boyer, H 2009, Resilient cities: responding to peak oil and climate change, Island Press, Washington, DC.

6 Urban metabolism see: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=2ahUKEwi745mO267oAhU9mXIEHaGuAngQFjABegQIBhAB&url=https%3A%2F%2Fen.wikipedia.org%2Fwiki%2FUrban_metabolism&usg=AOvVaw23Zt_wyGgKSwMdHpo_0Rn6

7 E.g. see Kates, RW 2000, 'Sustainability Science', World Academies Conference Transition to Sustainability in 21st Century 18 May 2000, Tokyo, Japan, doi: 912f5115514053e86; op cit Girardet 2008; Jenks, M & Jones, C (eds) 2010, Dimensions of the sustainable city, Springer, London; Birkeland, J 2020, Net-Positive Design and Sustainable Urban Development, Routledge NY & London.

8 Metabolic processes refer to the inputs and outputs and what the inputs produce based on eco-system theories – in this case applied to the fabric and infrastructure of the metabolism of an urban system including energy flows (See Girardet op. cit. 2008, p.123)

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Sustainability in Transportation:
Actions and Ideas from the Santa Fe, New Mexico region

Gary Brett Clavio

(Rio Grande- Road to Taos)
Photo by Clavio

(Rio Grande- Road to Taos)
Photo by Clavio

INTRODUCTION

The territorial area of Santa Fe County is 1,907.5 miles^2 (3069.8km^2)[1]. It includes, within its geographic boundaries, the City of Santa Fe, a portion of the City of Española, and a portion of the Town of Edgewood.

The modern city of Santa Fe, New Mexico (USA) derives its name from *La Villa Real de la Santa Fé de San Francisco de Asís* . The city was established in 1610 by Spain as the capitol of the province of Nuevo México, Nueva España. Before that, the place was called Ohgeh Pohgeh, in the native Tewa language. Today, it is the county seat of Santa Fe County and the Capitol of New Mexico, a State since 1912. As of 2018, the city of Santa Fe had a population of 82,980, while the county of Santa Fe had a population of 150,056[2].

The non-urban populations live in smaller, unincorporated settlements defined as either traditional or contemporary. There are approximately 30 traditional community settlements. Their characteristics include clustered development and an agricultural heritage. There are also approximately 30 contemporary community settlements. Their characteristics include major and minor residential subdivisions and automobile-oriented development.

In addition to the old Spanish and the more recent American settlement types, there are also the ancient sites and the reservation lands of Native American tribes within the county. Reservation lands are characterized with old and new Pueblo developments. The pueblos and tribal reservation lands are sovereign nation lands, held under trust by the US Department of the Interior- Bureau of Indian Affairs. The Tribes have their own in-house, competent planning departments. Communication and collaboration are key to achieving cohesive regional planning.

There are also ancient Native American pueblo settlements and heritage sites in the county, including a portion of Pecos Pueblo. According to legend, the pueblo hosted, pan-continental cultural gatherings and trading events with Aztecs from Mexico trading macaw feathers, coastal Californian tribes trading shells, and Plains tribes trading furs. The pueblo tribes in the area traded turquoise, pottery, food supplies, and hosted in a temperate, central gathering place.

Figure 1: Prehistoric/ Traditional Community agricultural building Photo by Clavio

Figure 2: Contemporary Kachinas
Photo by Clavio

Figure 3: Adobe wall at Pecos Pueblo
Photo by Clavio

Figure 4: Public art
Photo by Clavio

Santa Fe has three principal historic transportation corridors, derived from prehistoric native trails: South to Mexico City (El Camino Real de la Tierra al Dentro), West to Los Angeles (Old Spanish Trail), and East to the Missouri River and Chicago (Old Santa Fe Trail, Route 66, Southwest Chief). This transportation network helps to explain how these three cultural groups came to be in the Santa Fe area today- Native American people, people of Spanish descent, and people of American descent. These routes continue today, though along improved alignments.

DEVELOPING THE TRANSPORTATION PLAN

The methodology used to develop the transportation plan consisted of researching existing transportation policy documents from internal and external stakeholders. Internally, those documents consisted of the County's *Strategic Goals;* the County's land-use plan, '*Sustainable Growth Management Plan*[3]*,* the many specific unincorporated Community Plans, District Plans, and Corridor Plans; the land-use code, '*Sustainable Land Use Development Code,'* the Santa Fe Metropolitan Planning Organization's (MPO) '*Metropolitan Transportation Plan,'* the transportation plans of two relevant Regional Transportation Planning Organizations (RTPOs), the Transportation Plan of the State, the short-range and long-range transit plans of the local and regional transit agencies, and other historical plans and documents.

Transportation plans from similar western US places were also reviewed, such as from Boulder, Colorado[4] and San Luis Obispo, California.[5] Sustainability, outdoor recreation, rural characteristics and transportation mode equity were seen as common values and concern in these plans.

Mapping of the 60-odd communities was then performed using multiple layers of GIS data to illustrate the existing and proposed transportation infrastructure: roads, trails, transit stops, and bicycle routes. The maps also identify the transportation asset's ownership, and its operational and maintenance jurisdictions.

The in-house plan-development process has been an iterative one, communicating with management and presenting plan processes and products to an appointed Transportation Advisory Committee for comment.

That volunteer advisory committee serves a community participation role. It's members provide technical and contextual feedback. They have diverse professional backgrounds and expertise. The group provides an advise and consent role to the Board.

The Board will ultimately consider voting on adoption of the Plan. Interested community members and transportation stakeholders such as the MPO, RTPOs, and Transit Districts will also review the plan and make any comments. One of the first steps for the Transportation Plan was to establish a vision:

> *'To provide and maintain high-quality transportation facilities and amenities for the communities in the County.'*

The mission statement of the Transportation Plan is to:

> *'Plan, design, operate and maintain a robust, multimodal transportation system with programs and policies that reflect stakeholder partnerships and constituent collaboration.'*

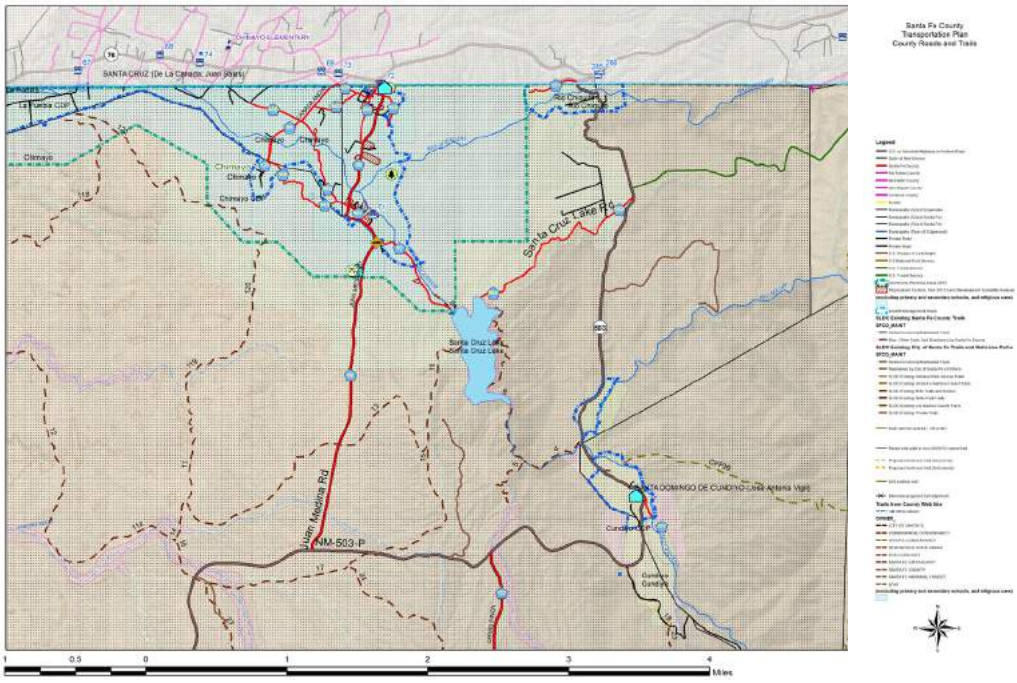

Figure 5: (top) Roadways and amenities map of three traditional communities: Roads, trails, bus-stops, off-road and on-road bike routes.'

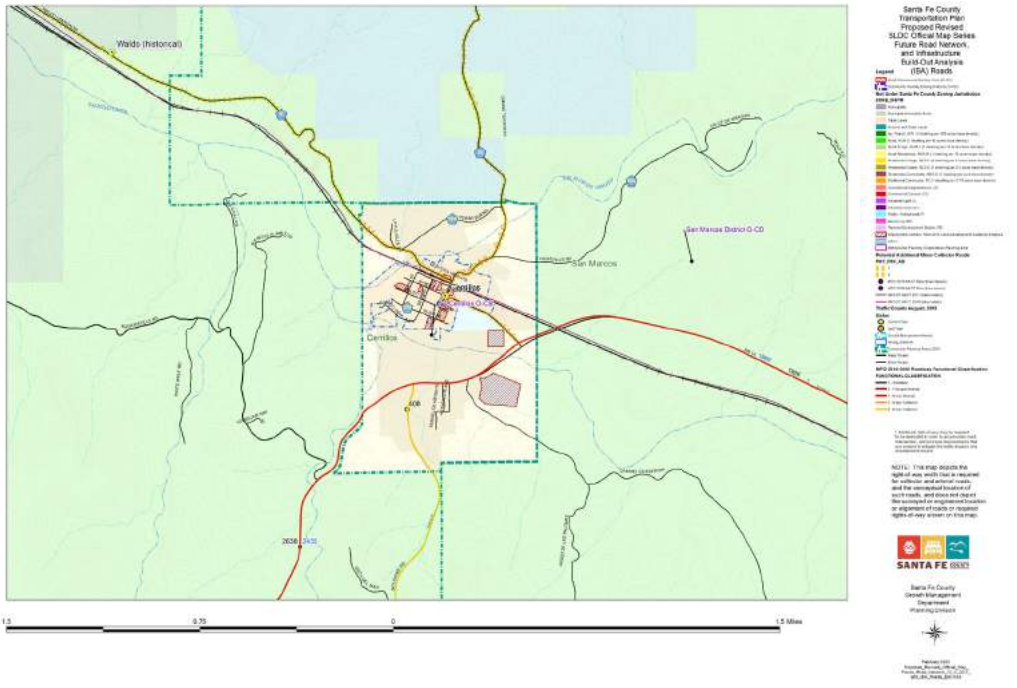

Figure 6: (bottom) Functional Classification of Roadway Systems Map- Existing Conditions' Maps by Clavio

Figure 7: Wide urban sidewalks
Photo by Clavio

Figure 8: Maintaining the rail line along the Rail Trail
Photo by Clavio

Figure 9: Extending the Rail Trail
Photo by Clavio

Figure 10: Alignment of a future multi-use trail to a transit station
Photo by Clavio

With that, eight transportation plan goals were integrated from the existing transportation goals of internal and external stakeholders, such as the Transit District, the MPO, the RTPOs, the State Department of Transportation, and the United States Department of Transportation:

1 Provide County communities with safe transportation systems.
2 Promote sustainability in transportation- integrating environmental conservation, sustainable economic development and sustainable energy use.
3 Provide transportation systems that promote a healthy community, healthy lifestyles and a clean natural, cultural and built environment.
4 Implement transparent and accountable transportation programs and policies that reflect regional partnerships and constituent collaboration.
5 Expand the integrated transportation network with increased transit, multimodal equity and high-quality facilities to enhance user experiences for all modes.
6 Utilize flexible, context-sensitive transportation solutions to create inviting public places and walkable, mixed-use communities.
7 Preserve and improve the existing transportation systems.
8 Provide great transportation-oriented customer service, public outreach, information and emergency communications.

While each of the plan's eight goals pertain to some aspect of sustainability, Goal 2 attempts to specifically address the transportation plan and its relationship to environmental conservation, sustainable economic development and sustainable energy use.
The planning process then developed the following objectives, actions, and ideas in support of Goal 2:

Objective A
Base transportation design standards on a hierarchy of vulnerability- which begins with pedestrians. The design hierarchy, in order of priority, should be:

1 Pedestrians
2 Bicycles
3 Public transit
4 Vehicles

Actions

1 Incorporate these transportation values into the Development Code's Transportation Design Standards.
2 Incorporate Complete Street designs in road projects in Sustainable Development Area 1 to establish a safe and effective pedestrian and cyclist network within the County's future growth areas.

Figure 11: Rio Chama-natural wildlife corridor' Photo by Clavio

Figure 12: Bridge over Rio Chama' Photo by Clavio

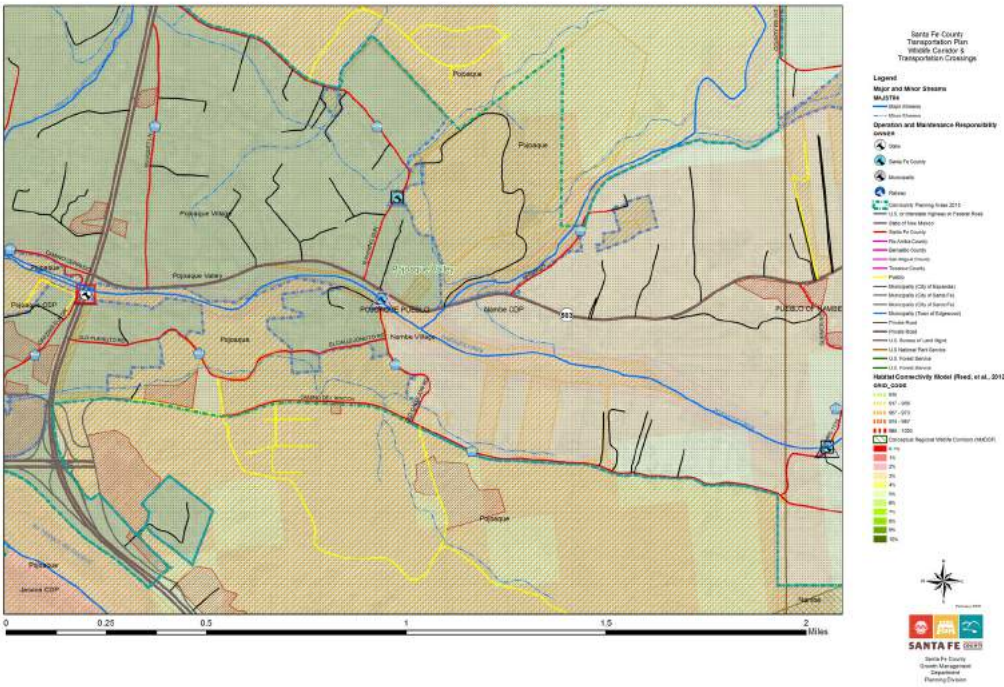

Figure 13: Potential wildlife and transportation corridor crossings map Photo by Clavio

Figure 14: Multi-use path under arterial intersection with commuter train crossing
Photo by Clavio

Objective B
Incorporate wildlife migration corridors into transportation planning.

Actions
1 Coordinate, collect and analyze traffic-safety and related wildlife crossing data from the State Environmental Bureau and Public Safety Departments annually, to inform on safety improvement priorities.
2 Prioritize and implement mitigation measures (I.e. wildlife tunnels/bridges) at hazardous wildlife crossing areas.

Ideas
› Establish a citizen science, or crowd-sourced, voluntary program of reporting interaction/collisions with wildlife along transportation corridors – develop a mobile phone application (or work with existing app) to host program and collect data.[6]

Objective C
Permit mixed-use and commercial development around transit stations to support transit ridership and support adjacent economic development.

Actions
› Work with transit agencies and MPO to identify existing and proposed transit stations.

Objective D
Reduce carbon emissions from the transportation sector.

Actions
1 Transportation projects shall comply with the National Environmental Protection Act.
2 Transportation projects shall consider design options that help reduce carbon emissions.

Ideas
1 Consider vehicle emission standards and smog checks.
2 Establish measures to reduce idling diesel vehicles; i.e. school buses, construction equipment.
3 Enhance traffic lanes, trails and corridors so that low carbon transportation is encouraged. Anticipate the advent of more widespread use of electric bicycles in future transportation options.

Interactive maps will be made publicly available via websites to communicate various aspects of the community transportation facilities. The interaction could include service requests and other comments on facilities.

5.6.1 Roadway and Amenities- Operations and Maintenance Information Map *Ownership and maintenance questions. Location of scenic pullouts and scenic routes.*

5.6.2 Pedestrian and Multi-use Trail Operations and Maintenance Map *Types of paths, trails, amenities and projects.*

5.6.3 Bicycle Routes and Level of Service Classifications Map *Off- and on-road routes and projects.*

5.6.4 Transit Routes Map *Bus and Rail routes and amenities*

5.6.5 Roadway System Functional Classification Map *Roadway system improvement priorities and classification mitigation projects.*

5.6.6 Electric Vehicle Charging Stations map *Location and type of charging stations*

5.6.7 Wildlife and Transportation Corridor Crossings Map *Wildlife crossing improvement priorities and roadway mitigation projects.*

5.6.8 Transportation Improvement Program Map *Lists of Transportation Projects by mode, community, and approximate cost. 5- , 10-, 20-yr. horizons.*

CONCLUSIONS

The long-range plan attempts to integrate the existing transportation stakeholder goals and categorize them into unified, thematic goals.

One of the categories of the plan's goals is Goal 2: "Promote sustainability in transportation- integrating environmental conservation, sustainable economic development and sustainable energy use." By first creating a specific goal on transportation sustainability, a route can then develop using actions and ideas on how to get there.

In relation to the United Nation's Sustainable Development Goals (SDGs), the Transportation Plan Goal #2 is promotive of five of 17 SDGs.[7] For example, SDG #3 'Good Health and Well Being' is promoted with active transportation. SDG #11 'Sustainable Cities' is promoted with sustainable transportation design. SDG #13 'Climate Action' is promoted with alternative transportation and transit. SDG #14, 'Life Below Water' is promoted with bridges and riparian restoration. SDG #15, 'Life on Land' is promoted with wildlife crossings.

Principles of UN Habitat's 'International Guidelines on Urban and Territorial Planning' were also referenced in review of the proposed transportation planning process.[8] The local processes and principles are in harmony with the International Guidelines. The local authority has participatory methods, collaborative systems and transparent practices in place for transportation and community planning.

Transportation design standards may need to be reformed to help address the diverse form of communities. The two predominant community design types identified in the region were the traditional and the contemporary.

Figure 15: Traditional Pueblo Architecture
Photo by Clavio

Transportation design standards for each type of community could be redefined to better fit the community form. For example, standard road profiles and right-of-way requirements in the traditional communities could allow for narrower roads and pathways, while design standards for contemporary communities could require wider roads, separated bike lanes and sidewalks to complement their existing forms.

Identifying and programming for improvement the various transportation mode requirements is another objective of the plan. This will be based on evaluating each mode's Level of Service (LOS) in the community and attempting to elevate that LOS to as high a standard as possible. Any transportation facility with a poor LOS of D or worse would be prioritized. This method will help to identify any transportation infrastructure needs and how and why to prioritize their capital improvements.

Pedestrian mode

The pedestrian mode should remain a priority for the long-range future. Projects include linking and expanding upon existing pedestrian and multi-use networks. Current design standards require side paths in the rural areas and sidewalks in the urban areas.

However, retrofitting old and narrow traditional roads presents challenges, as there is little room left for sidewalks. A high-speed road with no sidewalk or side pathways, for example, has a poor pedestrian LOS. Small, traditional communities need improved pedestrian facilities and vehicle parking integration.

Retrofitting contemporary community arterial and collector roads that were built with no sidepath or sidewalk now need facilities like multi-use paths or side trails for walkability. Some such collector-level roads linking contemporary suburban developments to urban amenities are 10-miles long.

Bicycle mode

The bicycle route network grows with more requests for providing bike-friendly facilities and communities, particularly along scenic corridors. New, larger roads require side bike lanes or side bike paths.

Design standards are improving for separated and adjacent bike facilities along the collector and arterial roads. The designs aim to accommodate both the recreational and utilitarian cyclist.

Installing bike lanes along narrow traditional roads is difficult due to space constraints. Retrofits are challenging, expensive, and slow moving.

Creating multi-use trails for bikes and pedestrians is one way to create alternative transportation options for the contemporary communities. Multi-use trails offer a good bike and pedestrian LOS.

Figure 16: Rural Pueblo Bus Stop Photo by Clavio

Transit

Transit ridership is up in the region, despite low fuel prices and national downward ridership trends. Innovative and expanded regional bus and rail services are continuously being developed, serving more communities. Specialized transportation services also exist for seniors and people with disabilities.

Expanded and more frequent transit service is typically in demand. A need also exists to upgrade some of the rural transit stops for protection against inclement weather. Linking transit service to community facilities and community services is another objective. A bus stop with a bench, shelter, signage and an accessible path is good, but with infrequent service, that LOS decreases. Improved bus stop shelters should better reflect the local design characteristics.

Automobiles

The principle roadways are in good condition. Traffic is moderate compared to larger metropolitan regions. Many local roads are kept as dirt roads or gravelled.

Some large interchange projects are needed to improve mobility and to separate arterial roadways for safety. Unsafe intersections and long wait intersections indicate a poor LOS and may require functional system improvements, such as a bridge or interchange.

Separating wildlife corridors from transportation corridors with animal bridges or tunnel crossings is also an important safety and sustainability activity. Some locations may need multiple-sized crossings, for different sized animals.

Endnotes

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Transforming Cities to Mitigate Climate Change: Policies and Practice

Roman Pomazan

Forest fires in the Amazon, 2019

INTRODUCTION

Every year we witness the aftermath of increasingly severe examples of climate change worldwide. The melting ice of the Arctic and Antarctic, the Deep Water Horizon spill in Mexico Gulf, the increasing scale of forest fires in Siberia, equatorial Africa, the Amazon Basin and Australia, the drying and drought of traditional agricultural land, the increasing frequency and severity of fresh water flooding, tsunamis, earthquakes, and, hurricanes and typhoons. Expanding the negative influence of climate change are technogenic disasters, deforestation, excessive use of pesticide and mono-agriculture practices, industrial soil contamination, rising levels of air and water pollution, and, the Anthropocene mass extinction of species. All of these events affect the global economy and have transformed urban issues into a can of worms.

As urban citizen awareness increased, it led to a wave of climate emergency declarations starting in 2016 and spreading by 2019 to the European Union, the United States of America, Canada, Argentina and plenty of other countries and municipalities around the world.

Decision makers began to understand the dead-end implications of a climate changed economy decades after warnings were provided by environmentalists and scientists. As a result, different types of international, national, regional and municipal guidelines, declarations, directives, codes and laws have been promulgated to mitigate climate change, over the next few decades, by embedding the same into the urban policy fabric breakthrough policies and programs.

As of March 1, 2020, 1,388 places including 28 European Union countries acknowledged climate emergency. These proclamations declared the urgent need to speed up the achievement of global sustainability goals and demanded faster transition to renewable energy and a circular economy.

This article will present and analyze climate change mitigation policies at metropolitan level, their implementation and effects achieved during the second decade of the 21st century. This paper does not pretend to be a comprehensive report, but rather aims to highlight main trendsetters among the global cities that already declared climate emergency and developed green policies.

CLIMATE EMERGENCY MITIGATION POLICY

New York City

Among other common symptoms of climate change, New York City experienced devastating damage resulting from climate change induced hurricane in 2012. Over the course of 48 hours, this moderate (category 2) hurricane combined with unusually high tides destroyed approximately 300 homes, left hundreds of thousands of New Yorkers without power, damaged critical public and private infrastructure, and limited access to food, drinking water, healthcare, and other critical services. Over 69,000 residential units were damaged, and thousands of citizens were temporarily displaced. The economic damage was estimated to be $19 billion.

This event pushed city authorities to prepare and elaborate several legislative measures in 2014-2016 to release the 1.5°C plan in 2017 aligning New York City (NYC) with the Paris climate agreement.

Legislative transition started with Local Law 66 of 2014. Commonly referred to as the “80x50” plan, it codified the commitment of NYC to achieve 80% greenhouse emissions reduction compared to 2005 levels by 2050. Next, during the initial year of the Paris Climate Agreement’s implementation, NYC released Roadmap to 80x50, which reported best-in-class analysis and documented extensive stakeholder engagement to understand how 80x50 plan

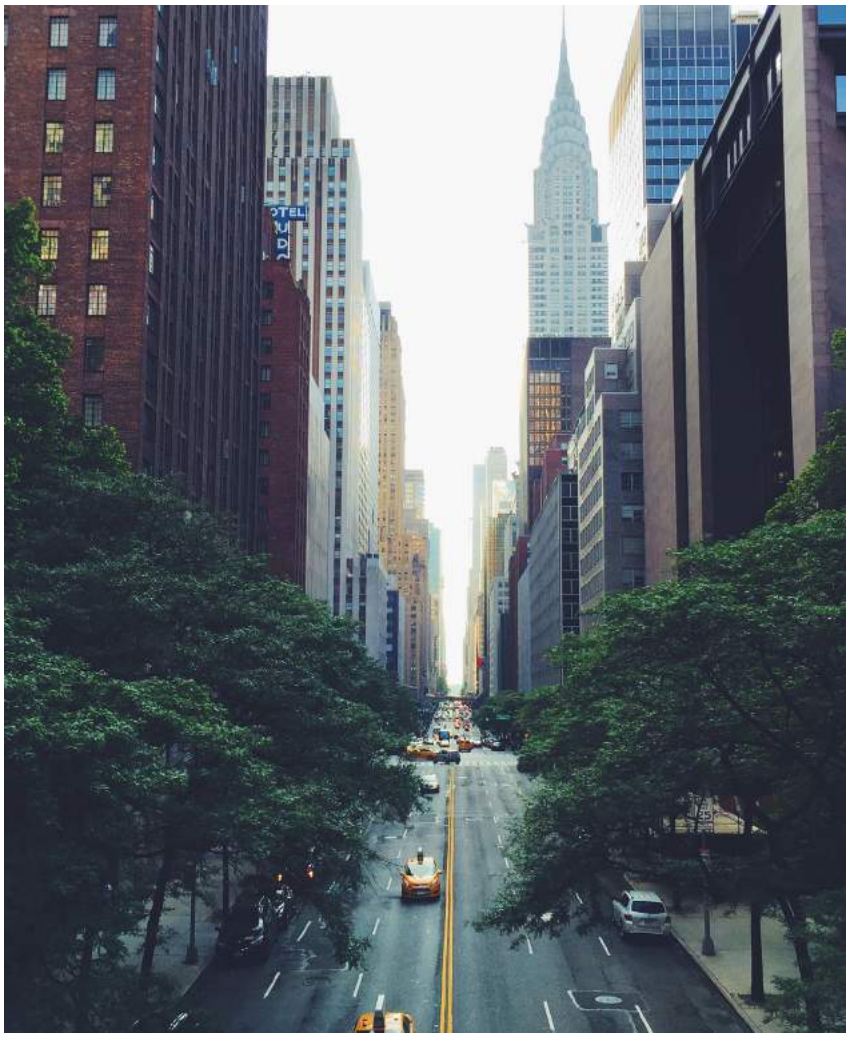

Figure1: New York City

Figure 2: Climate action by Extinction Rebellion, NYC

Figure 3: Manhattan downtown

goals could be achieved with existing technology across the city's buildings, energy supply, transportation, and waste sectors. All these precedent measures were later embodied in the 1.5ºC plan.

In 2019 the NYC City Council approved a resolution on climate emergency, lobbied by green activists. The resolution calls for a regional just transition and climate emergency mobilization effort. While this resolution is only a petition, without the effect of law, it proclaims the need for speeding up changes in the economy.

New York City's main strategy to achieve climate change remediation is the 1.5ºC plan. It articulates both near-term goals to be achieved by 2030 and a long-term plan to be accomplished by 2050. The plan includes 13 climate actions in the areas of: building energy performance mandates, deep energy retrofits in city-owned buildings, advanced building codes, property assessed clean energy financing, a NYC building programs, sustainable transportation, organics separation,100% renewable electricity for city operations, renewables-based electric supply, electric vehicle charging infrastructure, carbon and other externalities accounting, global cities protocol for carbon neutrality, and, enhanced climate communications.

This plan also envisions protecting the south part of Manhattan from sea level rise by constructing a two-block wide dam by 2100. Justification for the dam project was preservation of the area's $60 billion worth of property, characterized as one of the core centers of the American economy. The resulting controversy has provoked public discussion about the public and private nature of this project.

Despite its progressive planning, New York City still battles with CO_2 emissions; the majority of which comes from buildings. Environmental scientists report that over 70% of total carbon dioxide emissions are produced by buildings and that just 2% of all the buildings produce half of the total climate-altering output.

The Plan's progress has been slow. Local environmental groups called on city lawmakers in 2016 and 2017 to mandate 80% cuts to building emissions and energy use by 2050 by requiring dramatic upgrades to the boilers, water heaters, roofs and windows of existing skyscrapers. These efforts failed due to powerful resistance of the real estate lobby. Nevertheless, New York environmentalists continue to push legislators to mandate 80% reductions of CO_2 by 2050. In 2018, authorities of New York City started an offence forcing property owners to retrofit and make their buildings more energy efficient.

San Francisco

In the past few decades, metropolis of California have experienced climate change induced reduction in annual rainfall, leading to forest fires and air pollution.

The San Francisco environment strategic plan posed the following 5 goals to be achieved between 2016 and 2020: promotion of healthy communities and ecosystems; leadership in climate actions; strengthening of community resilience; elimination of waste; and, the amplification of community action.

By 2016 San Francisco cut 30% of CO_2 emissions and developed various strategies briefly described in the following paragraphs.

The Vision Zero SF Two-Year Action Strategy outlines the project and policy changes to build safe and livable streets. It encompasses a range of comprehensive solutions to address street safety proposals needed to achieve the goal of zero deaths on City streets by 2024.

Successfully completed in 2017, the Transportation Sustainability Program (TSP) consisted of three components: enhanced transportation to support growth, modern environmental review and encouragement of sustainable travel. It sought to improve and expand upon San Francisco's transportation system to help accommodate new growth. Part of this overall program is the Transportation Demand Management (TDM) Program, designed to work with developers to provide more on-site amenities to encourage smarter travel options so people can get around more easily without a car. Another element is the SF Municipal Transportation Agency Bicycle Strategy and their bike program, which aims to modify the transport modal split by increasing bicycle and pedestrian shares.

Another element of the strategic plan, the Electricity Resources Plan, reinforces the goal of delivering 100% carbon free electricity to all San Franciscans by 2030. Their 0-100-Roots is a city climate action framework that helps to meet the challenge of climate change through innovative policies, programs, and partnerships. It aims to achieve 0% waste, 80% sustainable trips, 100% renewable and regenerated energy by 2030.

Finally, many of San Francisco's NGOs developed a climate emergency resolution in April 2019. In addition to political support it had the support of the following groups: SF Tomorrow, Bayview Hunters Point Community Advocates, Mothers Out Front, 350 Bay Area, 350 SF, Citizens' Climate Lobby SF, Sierra Club SF Group, SF Labor Council, SEIU 1021, Jobs with Justice, and others. The final resolution included a strong focus on environmental justice, the central role of organized labor, and support for frontline communities in the transition to a fossil fuel-free economy, the achievement deep emission reductions at emergency speed, and the advancement of climate adaptation efforts to address unavoidable current and future climate change impacts. It proposed the development of a budget that enables urgent climate action and avoids further investment of public dollars in fossil-fuel reliant infrastructure when there are clean energy alternatives. It supports public sector employees and ensures a climate resilient future for all San Franciscans.

Figure 4: (top): San Francisco

Figure 5 (bottom): Vancouver

Vancouver

In 2011, Vancouver, the 3rd largest Canadian city, adopted a green strategy. The Greenest City 2020 Action Plan (GCAP) identifies goals in ten areas: greening of the economy, climate leadership, promotion of green buildings, transportation programs, zero waste, access to nature, lighter footprint, clean cater, clean air, and local food. In 2019, 80% GCAP's goals had been achieved.

Besides, the Renewable City Strategy targets 55% of total energy production from renewable sources by 2025 and a full transition of the metropolis to renewable energy before 2050. Also, the Strategy aims to reduce GHG emissions by 80%, from the 2007 levels.

In 2019, Vancouver City Council approved a Climate Emergency Response report calling for an acceleration of actions to reduce carbon emissions and 100% renewable energy by 2050. The report consists of six major strategic policies and identifies 53 tactical actions. The six big policies envisage:

1 walkable complete communities for 90% of the population by 2030,
2 safe and convenient active transportation and transit with the goal of two thirds of all trips provided by sustainable transport by 2030,
3 pollution free cars, trucks and buses pursuing a goal of half zero-emission driven kilometers by 2030,
4 zero emission space and water heating targeting 100% replacement of all equipment by 2025,
5 lower carbon construction with a 2030 goal to reduce embodied emissions in new buildings and construction projects by 40% compared to a 2018 baseline,
6 restored forests, coasts, and forest and coastal ecosystems, in Vancouver and the surrounding region to remove one million tons of carbon pollution annually by 2060.

Auckland

While Auckland acknowledged the common results of climate change like temperature rise, sea-level rise, change of precipitation mode and shifts of fauna distributions, all previous climate emergencies during the past few decades were related to sea and wind events. In 2019, as a result of social demand for urgent climate actions, the Auckland Council declared a climate emergency and invited citizens to participation in the creation of framework measures.

After 2 months of collecting ideas online, the assembled framework outlined 11 key actions to radically reduce emissions and rapidly increase Auckland's resilience to the impacts of climate change. The proposals included:

1 creation of a concrete foundation for participatory planning,
2 enhancement, restoration and connection of natural environments,
3 development of climate-compatible development and infrastructure,
4 the transformation of existing buildings and places into healthy, low impact and multi-functional,
5 The delivery of clean, safe and equitable transport options,
6 movement to a zero carbon, climate-resilient economy,
7 achievement of a more resilient Aucklander society that reduces its carbon footprint,
8 Te puawaitanga o te tangata – encouragement of self-sustenance and well-being of Māori communities,
9 achievement of youth and inter-generational equity,
10 a shift to decentralized renewable energy, and,
11 growth a low-carbon and resilient food system.

This framework was to be funded and achieved during a 10-year budget period.

The Auckland Plan 2050 supersedes the previous Auckland Plan 2012 and continuously develops ideas to transition the city into one of the world's most livable metropolis by focusing on six outcomes: Belonging and Participation, Māori Identity and Wellbeing, Homes and Places, Transport and Access, Environment and Cultural Heritage, Opportunity and Prosperity. This strategy engages 33 metrics to provide incremental analysis for each of the Plan's outcomes via a yearly scorecard and a more extensive report every 3 years.

The low carbon strategy describes actions to reduce overall emissions by 40% by 2040 by rethinking the functioning of the built environment and infrastructure, energy generation, travel, waste, forestry and agriculture.

Developed in 2019 the Auckland's Urban Ngahere (Forest) strategy aims to increase canopy cover to 30 per cent across Auckland's urban area, and at least 15 per cent in every local board area. It is intended to enhance the associated social, environmental, economic and cultural benefits, address the unequal distribution of canopy cover in urban Auckland, increase the network of green infrastructure on public land, improve links between green spaces by establishing ecological corridors, engage effectively with landowners to support urban ngahere on private land, plant diverse tree and plant species on public land, share knowledge of urban ngahere, instill a sense of pride in Aucklanders for their urban ngahere. To achieve these objectives the Forest strategy identified nine principle ideas to guide the effort:

1 right tree in the right place,
2 preference for native species,
3 ensure urban forest diversity,
4 protect mature, healthy trees,
5 create ecological corridors and connections,
6 access for all residents,
7 manage urban forest on public and private land,
8 deploy regulatory and non-regulatory tools, and,
9 managing the whole lifecycle of urban trees.

The Regional Pest Management Strategy aims to minimize harm for endangered species, species diversity, water quality, recreation, international trade, human health, soil resources, Māori culture and primary production in Auckland Region. The Auckland Growing Greener strategy focuses on the four areas: urban transformation, zero waste, nature regeneration and water treatment.

The Waste management plan advocates reduction of waste landfill until 2040 through using nine actions:

1 seek an increased waste levy,
2 encourage producers and consumers to think more carefully about the life cycle of products,
3 work closely with the commercial sector to manage what happens to organic, plastic, and construction and demolition waste,
4 create a network of 12 community recycling centers across Auckland,
5 focus on reducing litter, illegal dumping and marine waste,
6 continue to improve curbside rubbish and recycling collections,
7 begin offering curbside collection of food scraps,
8 address local waste practices, and,
9 partner with others to achieve a zero-waste Auckland.

Figure 6 (top):
Auckland

Figure 7 (bottom):
Berlin waterfront

Berlin

During the last decade, Berlin experienced increasing hot temperatures and heat waves corresponding to worsening public health in the summer, changes of precipitation and some extreme weather events. In 2019, in response to a petition signed by 43,522 Berlin citizens, the Berlin's President of the House of Representatives, the Senate and the land Parliament declared climate emergency for the capital of Germany.

Klimanotstand Berlin considers measures to accelerate a non-carbon future by eliminating the use of fossil fuel in the city in 10 years, incentives to encourage a meat-free food transition, and, increases in take-off and landing fees at Berlin airports.

Also, the Urban Development Concept - Berlin 2030 envisages future development of the metropolis guided by eight strategies:

1 strengthening the economy with smart knowledge,
2 unleashing strengths through creativity,
3 safeguarding employment through education and skills,
4 reinforcing neighborhood diversity,
5 city and green growing together,
6 laying the groundwork for a climate-friendly metropolis,
7 improving accessibility and city-friendly mobility, and,
8 shaping the future together.

Two of them – 'city and green growing together' and 'laying the groundwork for a climate-friendly metropolis'– directly apply climate change mitigation measures aimed to optimize and enhance local green connections, to define green and other open spaces and adapt to climate change, to strengthen links between open spaces and to structure important locations with international influence using urban planning.

Singapore

The Asian stronghold of international trade is threatened with climate change as never before. Singapore is concerned about sea level rise, increased precipitations, warmer temperatures and heat islands, and, overlapping smoke haze from Borneo forest fires. Considering all these threats plus potable water scarcity and fragile tropical ecosystems, the city-state initiated several strategic actions on climate change mitigation.

Singapore began to develop a Long-Term Low-Emissions Development Strategy (LEDS) to transition to a zero-emission economy by 2050. The main issues discovered during the participatory planning process were: the need for incentives and knowledge sharing; high capital costs associated with the achieving the goal; low return-on-investments; and, difficulties in obtaining developable sites to implementing improvement projects.

The building industry identified other problems. A split of incentives for tenants and landlords was highlighted as an issue as was the enhancement and expansion of Mandatory Energy Labelling Scheme (MELS); and the Minimum Energy Performance Standards (MEPS) to household appliances.

Mobility issues were also identified. These included switching from private to public transport, disincentives and penalties for private car ownership and road usage, scarcity of EV charging infrastructure, the existing price differential between EVs and ICE vehicles, and the shortcomings of existing EV battery technology.

Singapore's Energy plan focused on four ideas: improved efficacy of natural gas-fired power plants, development of 2 gigawatts of solar power by 2030, cost-competitive regional power grids, and carbon capture utilization and stor-

age as well as hydrogen. In the area of renewable energy, the intermittency of sunlight and land constraints were cited as significant challenges to harness solar power. Potential energy losses and interconnection costs were stated as barriers to the establishment of an ASEAN energy transition grid.

Green finance, research and development and technological solutions were cited by respondents as being key enablers for green growth. A common concern raised was the need to retrain workers in emission-intensive industries for new jobs in clean energy industries. Singapore's commitment to research, innovation, and enterprise in the sustainability domain started as early as 2006, when clean energy was identified as a strategic area of research to create new industries and enable high growth. Since then, initiatives focusing on solar PVs, green buildings, green data centers and waste-to-energy have been launched.

Lifestyle practices were also seen as a key challenge to collective climate actions. Lifestyle changes included a switch to climate-friendly diets, reducing waste and plastics use, and the adaptation of greener lifestyle practices. These changes were to be achieved through educational campaigns and engagements about climate change, school curricula with more emphasis on climate change and environmental protection, regular meetings to consult the public on policy initiatives.

Singapore's National Climate Change Strategy and Singapore's Climate Action Plan estimate that 60% of total CO_2 emissions come from industry, 17% - from buildings and 16% - from transport. The Climate Action Plan states overall goals of achieving achieving 75% of public transport mode share, Green Mark Standards for 80% of all buildings, and more than 700 km of cycling paths by 2030. The Carbon tax was mandated since 2019 and expected to cover over 80% of national CO_2 emissions. Within the Public Sector Sustainability Plan 2017-2020, Singapore hired 145,000 sustainability officers for 80 national agencies to hasten transition to a climate-proof and resilient future.

Singapore has been famous for its breakthrough technologies. In climate change mitigation, it has not remained aside. The Tuas Water Reclamation Plant and Integrated Water Management Facility aimed to reap process synergies and benefits from the water-energy-waste nexus. In 2019. Singapore invested $0.9 billion in R&D sector for energy efficiency within Singapore's Living Labs. Moreover, Singapore's National Parks Board has pioneered the first biophilic urban policy addressing ecosystems and ecology as a whole, comprising development world-class gardens, enriched biodiversity, while involving the 3Ps- People, Public, and Private sectors.

Doha

Since 2008, Qatar has been developing a national strategy of sustainability encompassing human, social, economic and environmental pillars. The environment pillar seeks a balance between development needs and environment protection, deals with local environmental issues including the impact of diminishing water and hydrocarbon resources, pollution and environmental degradation, as well as international environmental issues such as the potential impact of global warming on water levels in Qatar and thereby on coastal urban development.

The main efforts in climate change mitigation have been implemented through several projects. The largest is the adoption of compressed natural gas (CNG) as a fuel in the transport sector which has increased fuel security and additionally allowed to reduce greenhouse gas emissions. As a result, the Hamad International Airport (HIA) reached Level 3 Optimization Airport Carbon Accreditation program by the Airports Council International (ACI).

Figure 8 (top):
Singapore. Marina Bay

Figure 9 (bottom):
Doha downtown

There also has been the Launch of solar-power stations as well as electric bus routes feeding the Doha metro system. Al-Shaheen Oil Field Gas Recovery and Utilization Project, Jetty Boil-Off Gas (JBOG) Recovery Facility supplement the idea of CO_2 reduction in energy sector.

Also, the State of Qatar became a co-founder of the inter-governmental Global Green Growth Institute (GGGI), dedicated to supporting and promoting strong, inclusive and sustainable economic growth in developing countries and emerging economies. Global Green Growth Institute aims to deliver impact through six strategic outcomes:

1 GHG emission reduction,
2 creation of green jobs,
3 increased access to sustainable services, such as, clean affordable energy, sustainable public transport improved sanitation, and, sustainable waste management,
4 Improved air quality,
5 adequate supply of ecosystem services, and,
6 enhanced adaptation to climate change.

GGGI's Strategic Plan 2015-2020 sets the strategic framework for the organization to support partner countries transition toward a green growth model.

CONCLUSION

New municipal and regional parliaments are declaring climate emergencies every other month. Almost all are initiated by long term grassroot movements led by environmental activists struggling for resilient public spaces, social justice and climate change mitigation. Despite of tons documents and strategies previously developed by cities before, climate emergency declarations manifest the good will and concordance for environmental protection.

To achieve declared goals in an accelerated way, metropolises need to overcome a plethora of challenges, engage corporate and international- trade stakeholders, review and revise several legal regulation. Despite the need for speedy action, climate emergency recognition remains a formal measure for initiating accelerated actions amid the influence of energy monopolies and corporations.

Further inhibiting efforts is the fact that all five of the leading CO_2 – emitting countries still lack climate emergency declarations despite their total emission amounting to 57.2% of the global CO_2 emissions. China, USA, India, Russia and Japan have not declared climate emergency on national level. Moreover, some of these countries recognize circular economy and transition to non-carbon renewables as a critical threat to national economy. Carbon-emitting corporations in energy, construction, transport, food and manufacturing areas also have immense leverages on national and municipal economies and can be conservative about the need for change. Moreover, in many developing countries a carbon-emitting economy concept is not embedded in their social-economic models. Only four countries – the United Kingdom, Ireland, Canada and France – have declared climate emergencies, though the nations still give a combined $11 billion in fossil fuel subsidies each year.

Another large issue related to climate change is that the richest countries in the world producing more CO_2 are located in temperate climate zones, while the poorest countries in the equatorial and tropical zones are exposed to some of the most detrimental effects of climate change. In essence, unprecedented impacts of climate change disproportionately burden developing countries, hampering many developing nations' efforts to achieve the

Figure 10: 57% CO_2 emissions are produced by 5 countries: China, USA, India, Russia, Japan

Sustainable Development Goals. Without partnership assistance, capacity-building, technology transfer and financial support developing countries will fail to succeed in climate change mitigation considering their internal economic and political situations.

The achievement of the Sustainable Development Goals needs joint efforts of national and city authorities, academia and planning professionals, international aid and technology transfers for cities of developing countries. The private construction development business is the main stakeholder in the majority of metropolises, and obviously, economic profit remains the most valuable goal for them no matter how attractive is the idea to transition to a carbon-free economy.

Investments in the future are most tangible at the metropolitan management level, which is facing the challenges of climate change. Financial question is not less important for achieving the CO_2 mitigation goal of 1.5° C. Enormous costs are foreseen to transition to renewable energy, convert urban infrastructure and alter industrial supply chains. Fiscal and political support from key urban stakeholders remains a major implementation issue on the way to sustainable economy and mitigation of the threat of the global climate crisis.

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Leuven 2030: Co-Creating a Climate-Neutral Future

Jens Aerts, Miechel De Paep, Katrien Rycken

Figure 1: The Damiaan square after a place-making intervention, creating more space for people to walk, bike and meet

A bold climate policy is missing at international, regional and most national levels.[1] This is the clear message in the latest reports by the Intergovernmental Panel on Climate Change (IPCC), which found that there has not been a shift to a path consistent with staving off catastrophic climate change. Therefore, the post-oil city cannot be presented as a long-term vision that will only have to be dealt with as a reality after the world runs out of oil. Neither can cities and local governments wait until high-level policies trickle down.

The results of investment into new eco-cities, with technical innovation to reduce CO_2 e-emissions, are compromised because their benefits are not sufficiently large, and they are not affordable for all. Instead, the transition from fossil fuel to carbon neutral cities needs to be accelerated from within cities that exist already, where people can start to adopt sustainable behaviors and witness change today. Looking at the massive stock of existing urban infrastructure in these existing places, where an increasing majority of people live, climate challenge requires heavy upgrading of existing cities and requires mainstreaming climate action in all city development instruments and activities.[2] The demonstration and critical analysis of roadmaps to carbon neutrality in various existing cities is key.

This article describes Leuven 2030, a promising city-based initiative in Belgium, that is preparing the transition to a carbon neutrality by 2050, with the upcoming decade as a crucial period to deliver milestones in 2025 and 2035. It is an initiative that recognises the complex realities of the 21st century urban world: a decreased public investment climate, more ambivalent roles of public and private actors, multiple governance levels intersecting multiple sector domains, mostly compromised territories and a myriad of stakeholders, interest groups and information channels. Therefore, the article will not only describe Leuven 2030 as a vision and a program, but also as an innovative process of 'how to get things done', activating leadership throughout the community and seizing social and economic opportunities.

LEUVEN 2030, A PLATFORM FOR SUSTAINABLE CHANGE

A committed city, signatory of the Covenant of Mayors

Located roughly 25 kilometers east of Brussels, Leuven is a city in the Flemish Region, with just over 100,000 residents and nearly 60,000 university students. It is part of the Brussels Metropolitan region that counts approximately 1.8 million people. Leuven is known as a historic university city, home of the University of Leuven. The University was designed Europe's Most Innovative University in 2019, according to Reuters Ranking, embedded in an advanced eco-system of top hospitals, research centers and incubators.[3] Leuven is situated in a region with a high standard of living and a thriving knowledge economy. The city functions as a fertilizing ground for structural synergies between research centers, innovative economic investments and public government support, often called the triple helix model of innovation.[4]

In 2011 the city of Leuven became a signatory of the Covenant of Mayors. As such, it committed to achieving its share of emissions reductions and to developing a comprehensive adaptation plan. In addition, the city formally declared its ambition to transform Leuven into a climate-neutral city. However, the city council realized that evolving into a carbon-neutral society is a massive undertaking, beyond the scope of what city officials themselves are capable of doing. To help achieve this goal, in 2013, the city alongside key partners founded the non-profit organization Leuven 2030. This organization's purpose is to transition the climate neutrality goal into a project with citywide support and a

focus on social justice. Its Board consists of 60 founding members representing the various interests of the city of Leuven, policymakers, knowledge institutions, companies, civil-society organizations, and committed citizens. Over time, Leuven 2030 has evolved into a strong organization with over 500 members, underlining that collaboration is essential for bringing about a healthy, livable, resilient and climate-neutral city.

Science and evidence, to build a vision and a coalition

The city and the University of Leuven started a joint initiative in 2011 to establish a scientific approach to translate the commitment of the Covenant of Mayors, starting with a baseline emission inventory (BEI) and leading to scenario building exercises and a collective design process of all needed programmatic elements for change. The resulting 2013 scientific report elaborated hierarchies of actions, time horizons and needed monitoring and evaluation.[5]

The baseline emission inventory was drafted for 'Greater Leuven', which includes the territory of the city of Leuven and four neighboring municipalities that are strongly related to each other. To calculate the existing carbon footprint, a scientific team used the Bilan Carbone method, an internationally accepted method that makes a distinction between different types of emissions:

- Scope 1, as direct emissions produced on the territory of 'Groot Leuven';
- Scope 2 as indirect emission due to imported energy;
- Scope 3 as indirect emissions due to imported goods and activities.

Calculations were made with 2010 as reference year, aggregated in six sectors: energy production, transportation, residential, industry, trade and services, nature and agriculture. For scope 1 and 2 emissions, the report generated data in detail, highlighting that the built environment (residential and commercial) is responsible for 60% of Leuven's direct emissions, whereas transport takes up another 25%. These two sectors got thus earmarked as policy domain towards climate neutrality. The Scope 3 indirect emissions were qualitatively assessed as being0 three times larger than those produced by Scope 1 and Scope 2. This showed the need for integrated sustainable development on supra-local levels. It also demonstrated the need for more sustainable choices to be made by citizen consumers regarding imported food, products and travel modes outside the territory.

Using this baseline, the total carbon reduction and the attractiveness of the measure have been estimated for every sector and for various scenarios, on both the horizon of 2030 and of 2050. Supported with these quantified scenarios, it was found that it was not possible to aim for climate neutrality by 2030, but more realistic to aim for a drastic reduction by 2030 (up to 68%) and to achieve climate neutrality in 2050, which requires an emissions reduction of at least 80%.

The authors and steering groups involved in the making of the report consciously did not only focus on targets, but also on process. Therefore, the report recommended the need of an innovative partnership to be formalized in a long-lasting, neutral, 'quadruple helix' organizational structure, with its own decision-making bodies and personnel. The mission of that new organization would support the city in becoming a climate neutral and resilient city, by inspiring, informing, measuring, boosting and facilitating. The structure should also overlook the future integration and implementation of the measures and projects described in the report. In fact, it was believed that without such a participative, 'quadruple helix' structure, the transition to climate neutrality in Leuven may come to a standstill. On the other hand, provided the full support

Figure 2 (top): General Assembly of Leuven 2030

Figure 3 (bottom): Envisioning a carbon neutral Leuven, to communicate the sense of urgency to the broader public, after publication of the scientific report in 2013

of all key stakeholders in Leuven is obtained, it was believed that the city of Leuven could become one of the frontrunners in Europe, in line with great examples such as Freiburg, Copenhagen or Stockholm.

With the challenging horizons of 2030 and 2050 in mind and conscious that this implied a whole-system approach with full support of all tentacles of society, the city invested in the envisioning exercises and debates with a broader public. This involved the translation of scenarios into visuals that illustrate future-oriented modes of transport, possible uses of public space, possible living conditions, all embedded in recognizable contexts within the city fabric. While these visuals were not realistic, they facilitated communication and triggered debate towards viewing and experiencing the city with new eyes. This envisioning process also encouraged the city to reevaluate the current state of its public spaces and modes of transport.

A roadmap with eight ambitions

Based on the scientific report and the vision, the initiators of Leuven 2030 were able to start defining partnerships and start several initiatives and pilots. Stakeholders, led by the City of Leuven and KU Leuven, took significant steps to make quick wins. For example, since 2010 carbon emissions on Leuven's territory have stayed flat despite significant increases in the number of residents, jobs, and students. But this achievement is nowhere near enough and all stakeholders realized that a clear roadmap was needed to carefully describe the transition paths to climate neutrality, with a timeline containing all the steps the main stakeholders (local government, residents, businesses, knowledge institutions, and civil society) need to take by 2025 and 2035.

Therefore, in 2018 Leuven 2030 created the Roadmap 2025|2035|2050 with the help of the Bureau for Urbanism (BUUR) and many local experts, mainly from the city administration and the university staff. This document serves as a guide for achieving climate neutrality by 2050.[6] The roadmap built on the Scientific Report and broadened the scope to include a territorial scale focus and refined the timeline. Until recently, Leuven 2030's focus lay primarily on scope 1 and scope 2: the emissions produced directly on Leuven's territory (scope 1) and the emissions produced elsewhere to supply Leuven's electricity (scope 2). Yet Leuven is also responsible for emissions beyond the city's administrative borders, such as travel to and from the city, the production of

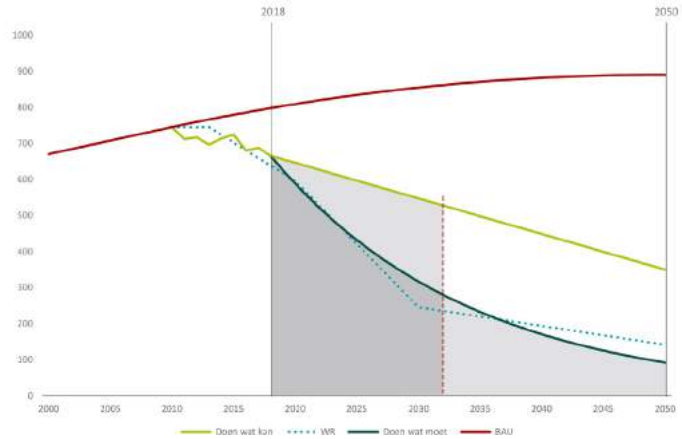

Figure 4: Scenarios for the CO_2 reduction in Leuven (scope 1+2): "business as usual", "scientific report", "doing what can be achieved", "doing what must be achieved". If we follow the path of "doing what can be achieved" the total CO_2 budget of Leuven will be depleted by 2034.

goods and food outside of Leuven. Reducing these emissions – scope 3 – also falls within the city's responsibility. This raises the bar significantly: Leuven will have to reduce its emissions by no fewer than 2,500 kilotons per year – nearly four times as much as projected in Leuven 2030's original goals.

Reducing emissions by at least 80% by 2050 (compared to 2010 levels) is the central goal of the Roadmap. This implies a reduction for scope 1 and 2 emissions of 67% reduction in 2030 and 81% reduction in 2050 (baseline 2010), not taking into account the industry sector. This means an annual reduction of carbon- emission of 5 to 6% needed to achieved. Meeting this challenge will contribute to, and shape, other goals as well, such as achieving a higher quality of life, increasing prosperity, and ensuring social justice. These goals are also part of the roadmap.

Inspired by the United Nations 2030 Agenda and the Sustainable Development Goals (SDGs), the roadmap is structured around eight ambitions for a climate-neutral Leuven. The first four ambitions together account for the four largest segments of Leuven's emissions output.

1 Climate-neutral living
2 Climate-neutral urban services
3 Climate-neutral mobility
4 Consuming sustainably
5 Producing renewable energy locally
6 Increasing urban resilience
7 Achieving climate neutrality together
8 Sharing knowledge and innovating

These ambitions are elaborated further into 80 project clusters, so-called 'sites', organized into 13 programs. Ten programs are closely related with urban built infrastructure, spatial networks and eco-systems. Three other programs build transversal strength between the other programs and emphasizing the importance of facilitating processes to be able to achieve results. Each program is key to achieve climate neutrality and should be considered a priority.

Project clusters are more than pilot interventions. They aim towards key breakthroughs and the acceleration of programs. To the extent possible, Roadmap 2025|2035|2050 defines quantitative targets and proposes measures to meet them. Every site will require a site leader, cooperation between multiple key actors, and the development and implementation of an action plan.

URBAN HARDWARE AND SOFTWARE TO REDUCE ENERGY CONSUMPTION

This chapter describes a selection of relevant programs to accelerate the transition to carbon neutrality that can be replicated in many other urban contexts. It is important to highlight that many of these programs are more effective when embedded in bigger scale actions supported by national and sub-national actions. But, in lieu of larger scale efforts, local actions, like Leuven 2030, can promulgate integrated approaches and innovation that inspired higher-level governance structures.

Energy efficiency of buildings and districts

Reducing energy consumption in buildings is the largest lever towards climate neutrality, as it represents 60% of the city's emissions. As a result, 60% of the existing housing stock has been selected to be thoroughly retro fitted by 2050 so that energy use is scaled back to the lowest possible level to conform to the

Figure 5: Example of ongoing renovation projects of a multi-unit housing complex to achieve energy efficiency

norm *Bijna Energieneutraal* (BEN), or 'Almost Energy-Neutral'.

Similar to most European countries and regions, the Flemish region has adopted the European Energy Performance Buildings directive (EPBD) in Energy Performance Legislation (EPB). It provides building standards and establishes financial aid mechanisms for individual owners and professionals to enable them to comply with these newer standards. Yet, the upgrading of energy performance has gone slowly with existing building stock. The current rate of retrofitting in Leuven is just shy of 1%.

The goal is to increase this figure to at least 3%, which corresponds to approximately 1,000 private market homes being retrofitted annually. Although retrofitting homes has become financially more realistic from an individual budget perspective, many homeowners lack interest or the technical knowledge and capacity to carry out the measures needed for retrofitting. Therefore, adequate support is needed, through neighborhood-level outreach to tailor advice on financing and technical regulations, and to create group markets to participate in joint retrofitting projects.

For the rental market, a separate, sector-specific approach will be developed. Together with public housing corporations, the city of Leuven has planned to upgrade 60% of the entire stock of more than 3000 affordable housing units by 2035.

In addition, a specific program is needed to reduce non-residential building energy demand by searching for efficiency in lighting systems and electronic appliances. The program invests in a focused outreach to important building owners, like the city and the university. A promising project is L.E.U.V.E.N. which is the acronym for 'Lower Energy Use Via an Extraordinary Network', a partnership between schools, companies, residential care centers. The partnership has collectively invested up to €50 million to improve the energy efficiency of their buildings. Leuven 2030 assembled the partners and secured €1.56 million in funding from the European Investment Bank. The project is expected to deliver a yearly reduction of 7,000 tons of CO_2 emissions. An important next step is to dissemination of what's being learned throughout this unique collaboration.

The city also will draft new legislation to insure that new large-scale residential buildings integrate their sustainable energy production, like district heating, in accordance with neighborhood-level energy strategies.

Sustainable Urban Mobility and Compact Urban Core Planning

It is crucial to maximize investment in existing urban and economic centers to accelerate a mobility shift and for the city region to stay attractive to for a growing number of inhabitants and economic investments. The current Spatial Structure Plan[7], approved in 2017, focuses on densification, efficient use of infrastructure and the better integration of different functions. This plan serves as a major legislative framework to achieve climate neutrality in 2050 because it considers demographic growth forecasts and has opted to decentralize growth within a city-region including eight other municipalities. This decentralized, compact growth plan is called *Regionet Leuven* and requires two investment strategies:

› a housing market which focuses demand to well-defined urban centers, and
› continued investment to insure a strong regional multi-modal transport network.

We expect that these actions will induce a modal shift to green mobility, resulting in a 20% reduction of car transport, a doubling of public transportation ridership and a 100% increase of commutes by bike. Only under these conditions can the required reduction of carbon emission in transportation can be achieved. This program implies intensive cooperation between municipalities in a series of urban centers within Leuven and 8 other municipalities.[8]

The development of an integrated, multi-modal mobility policy is complemented with an effort to reduce commutes by shifting digital public services and flexible workplaces to locations near public transport nodes. The mobility policy also requires a mental shift by 250,000 inhabitants, students and visitors. Therefore, the city council has approved an ambitious reduced auto circulation plan for the city center, calling for a 50% reduction of long-term parking spaces by 2025, and 100% reduction by 2030. To highlight immediate

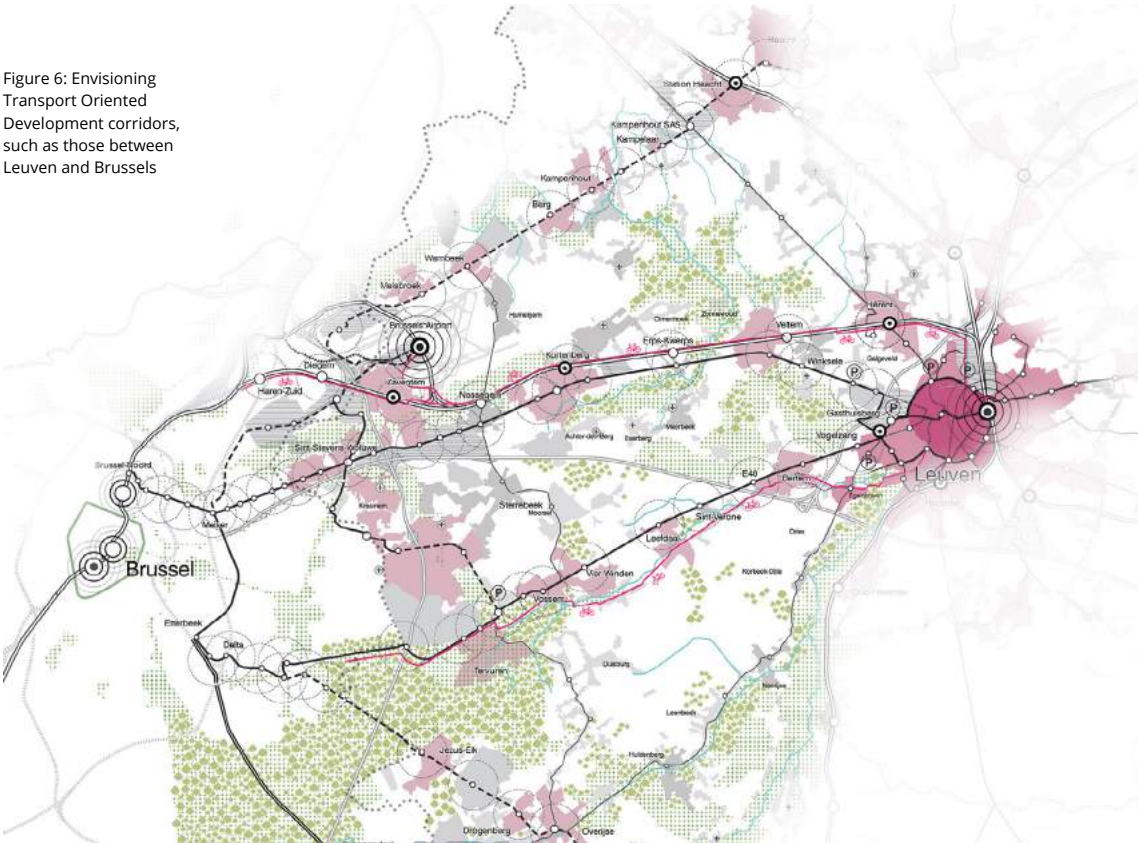

Figure 6: Envisioning Transport Oriented Development corridors, such as those between Leuven and Brussels

Figure 7: The community-based organization 'Straten Vol Leuven' piloted placemaking interventions at the Damiaan Square

advantages of this plan, the city and the province Vlaams-Brabant have supported a series of short-term interventions that takes space reclaimed from eliminated parking space and related car circulation areas and reprograms it for other uses. For example, the NGO, *Straten Vol Leuven*, has taken the initiative with three neighboring schools and inhabitants to design and install urban furniture, trees, play devices and a volleyball court on a colorfully painted surface. The idea is to create streets that are full of life. This intervention enables the use of public squares as a place for neighbors to meet, encourages a safe school environment and promotes streets that put children, pedestrians and bikers first. The quality of this rediscovered public space highlights the promotion of the city center as a safe and healthy place to live.

Other project clusters focus on greening mobility systems, such as the expansion of a car-sharing system to 1,000 vehicles in 2025, the provision of 100 public charging stations in 2025 and emission free cars in 2035.

Planning the local production of energy and heat

Currently, there little locally produced energy in Leuven. Renewable electricity and warmth provided by solar, wind, water, geotherm and biomass represents only 2.4% and 0.6% of the total use respectively, according to the Atlas Renewable Energy Flanders.[9]

As Leuven can hardly influence national and transnational energy production and distribution, it is logic to invest in local energy production that is renewable. This idea became a third level complement to the objective to reduce the need for energy (see 3.1 and 3.2 as main sectors that need energy) and improves the re-use of residual energy.

The city of Leuven aims to provide 25% of local heat demand by renewables in 2030, and 75% in 2050. For electricity production the roadmap aims to obtain 250 GWh, or more than half of the potential of photovoltaic panels, by 2050. This will require enormous efforts in energy transition, the adaptation

Figure 8: Leuven 2030 organizes a clean energy market, to promote and accelerate energy efficiency in individually owned buildings, bringing partners and citizens together for a scaled, collective approach

of regulations and the elimination of fiscal and juridical obstacle. To qualify for European funding for clean energy implies that Leuven needs to invest in a public local energy operator, provide premiums for individuals and professional building owners, elaborate a mechanism to establish energy service companies (ESCOs), and create tax shelter for companies that invest in energy production. Leuven also needs to prepare a juridical environment in which innovative pilot programs can be tested free of regulations to leapfrog the Belgian energy sector, which has been particularly slow to adopt innovations for many decades.

Another important step in the energy transition is the foundation of local energy cooperatives that ensure investment in production, distribution and stock by 2022. This would allow 40% of inhabitants to become member of local, green energy cooperatives and thus invest as individuals in the transition to collective, renewable energy production[10].

KEY SUCCESS FACTORS FOR A CLIMATE-NEUTRAL CITY

As a conclusion and a way to encourage other cities to develop programs like Leuven, we identify initial key factors needed to ensure success. As it is too soon to be able to define definitive results, this last chapter focuses on program elements that are innovative, but also reveals the enormous challenge for all cities to reduce their energy consumption by 80 percent by 2050. Among these challenges are the need for an extraordinary shift in existing investment streams, in governance innovation and in building broad support from all stakeholders as summarized in the following material.

Co-production and collaboration with citizens

Implementing Roadmap 2025|2035|2050 depends on broad support. Building and maintaining that support requires a permanent and citywide effort to raise awareness about the importance of taking action. This effort

Figure 9: Child-focused activities to gain broad support for the Roadmap Leuven 2030

Figure 10: Camping Zero Emissions in school yards

needs to focus on both the challenges facing Leuven and on the opportunities that those challenges present, for all societal actors: governments, companies, knowledge institutions, citizens, and investors. The quadruple helix model highlights the importance to get support from all citizens and stakeholders.

Knowing the enormous challenges on the road towards a climate-neutral city, it is absolutely crucial to engage citizens in a positive and continuous way, going from awareness raising to citizen science. Therefore, Leuven 2030 has invested in designing the needed architecture for societal transition, reaching out to the cornerstones of civil society and inviting them to share responsibilities and opportunities together. Leuven 2030 aims to get 1000 members in 2025 and to be known by every citizen.

The roadmap describes programs that start from the principles of universality and equity. Easily accessible information should be made available to anyone wanting to take action, but efforts should also target groups that are less inclined towards sustainability or simply have less resources to be able to put climate first in their daily life. It is important is to define activities that show short-term and tangible change, embedding them in a positive, yet more

complex and challenging story. The city and experts are curating community-led initiatives, such as *Straten Vol Leuven* (see chapter 3.2). Other activities focus on children and youth, a generation that is experienced in building social media campaigns themselves and is the strongest ally amongst all generations in climate action. For example, Leuven 2030 initiated Camping Zero Emission in 2013. It is an annual program held in the courtyards of several schools, that features content around climate and sustainability. The objective is to sensitize students about the climate crises and offer them time to define action. In addition, the city aims to mainstream climate in all educational curriculums.

Data, research and monitoring

Acquiring new knowledge, sharing best practices, and monitoring progress will be key to achieve targets and to ensure a continuous learning cycle. Therefore, the Roadmap is subject to change as the result of additional research as well as experimentation through pilot projects. As a city that has assimilated innovation and learning into its very core, Leuven will play a leading part in the sustainable transition. Through its own research and innovation – conducted by and achieved by the university, the city's many local experts, Leuven 2030, and Leuven MindGate – Leuven will make an active contribution to the growing base of knowledge surrounding climate action.

Without a baseline it is not possible to defining, monitoring or evaluating programs. Despite the high-level capacity available in Leuven, the draft baseline contains a lot of assumptions, due to a lack of supra-local data and because very few cities in Belgium and Europe map and monitor current carbon emissions. It makes the point that carbon-neutral city planning is young discipline.

The impact and effectiveness of implementation, but also the way in which it is carried out and structured, will be subject to continuous evaluation and optimization. Keeping a constant ear to the ground will ensure that innovative solutions and new insights, both from within the country and abroad, are not overlooked. From 2020 on, Leuven 2030 will organize a broad citizen survey each 6 months. Monitoring will happen on two levels: measuring the carbon emissions; and, measuring the impact of specific actions with well-chosen indicators. For both monitoring dimensions, partners will use an on-line tool that enables data input, storage and tracking of results. The on-line tool also facilitates knowledge sharing. [11]

Innovative governance models, learning by doing and knowledge exchange

One of the big challenges ahead is the development of governance approaches that connects and manages a whole constellation of innovation programs in ways that enable those initiatives to learn from one another and yield information about how to achieve transformation. A snowflake model regarding distributed leadership is needed, to achieve the targets in 2050, or to accelerate other activities and build broader support. This means that the city administration keeps its leading role but needs to rethink its governance model. Leuven 2030 is therefore the ideal platform to translate the commitment of stakeholders, to capture the value of emerging new initiatives, and to help them to scale-up (see chapter 2.1).

Yet, due to the limited time left to achieve carbon neutrality, adaptation of governance needs to happen on the fly. Leuven 2030 believes that learning by doing is key. This requires a clear approach to do this effectively and be sure that breakthroughs contribute to better and faster results in other program areas. Therefore, Leuven has joined an EU-funded initiative 'Healthy Clean

Figure 11: Workshops to prepare breakthrough projects towards a sustainable food strategy

Cities - Deep Demonstration for Radical Climate Action', that provides a format for 30 cities and regions to design, develop and implement new ways way to innovation and catalyzing change[12]. Leuven is part of a first cohort of ten cities which will learn how changes happen elsewhere and what governance structures have been put in place to address difficult issues.

Knowledge exchange between global cities is key to building governance capacity to achieve carbon neutrality of more cities. In March 2021, Leuven 2030 will host its second Road to 2050 conference, focusing on knowledge sharing of the city's eco-system with other cities and municipalities.

City-level Multi-layered planning and investment policy on city and city-regional scale

The urban system of the city is not limited to administrative borders. Citizens from neighboring municipalities are oriented to the city center as much as inhabitants within Leuven. They encounter the same urban challenges, such as pressure on the housing market and open space and traffic congestion. Hence, a city cannot become climate-neutral on its own, especially in the heavily urbanised and connected metropolitan region where Leuven is located.

Working with other municipalities, with regional and national governments and with other cities on the city-region scale is key. Therefore, the Roadmap calls explicitly for the installment of a city-regional federation, inspired by the *communautés urbaines* that are the metropolitan management administrations for French cities and their surrounding municipalities in the close periphery.

Fortunately, Leuven has anticipated this need of a supra-local governance system through previous territorial planning processes. In particularly the *Regionet Leuven* vision clarified the strong need of high quality regional public transport and densification of existing town centers. This effort already fostered a shared vision and consensus amongst various local, regional and national agencies to set up an intergovernmental cooperation in 2015.

Together with this top-down approach, the city used this momentum to build consensus about technical and political process and to start a bottom-up effort to mobilize a broader set of private and civic actors into the nascent Leuven 2030 structure. This broader support has encouraged the city to play its role further and promulgate, together with other leading cities in the Flanders Region, higher ambitions and accelerated action on regional and federal level.

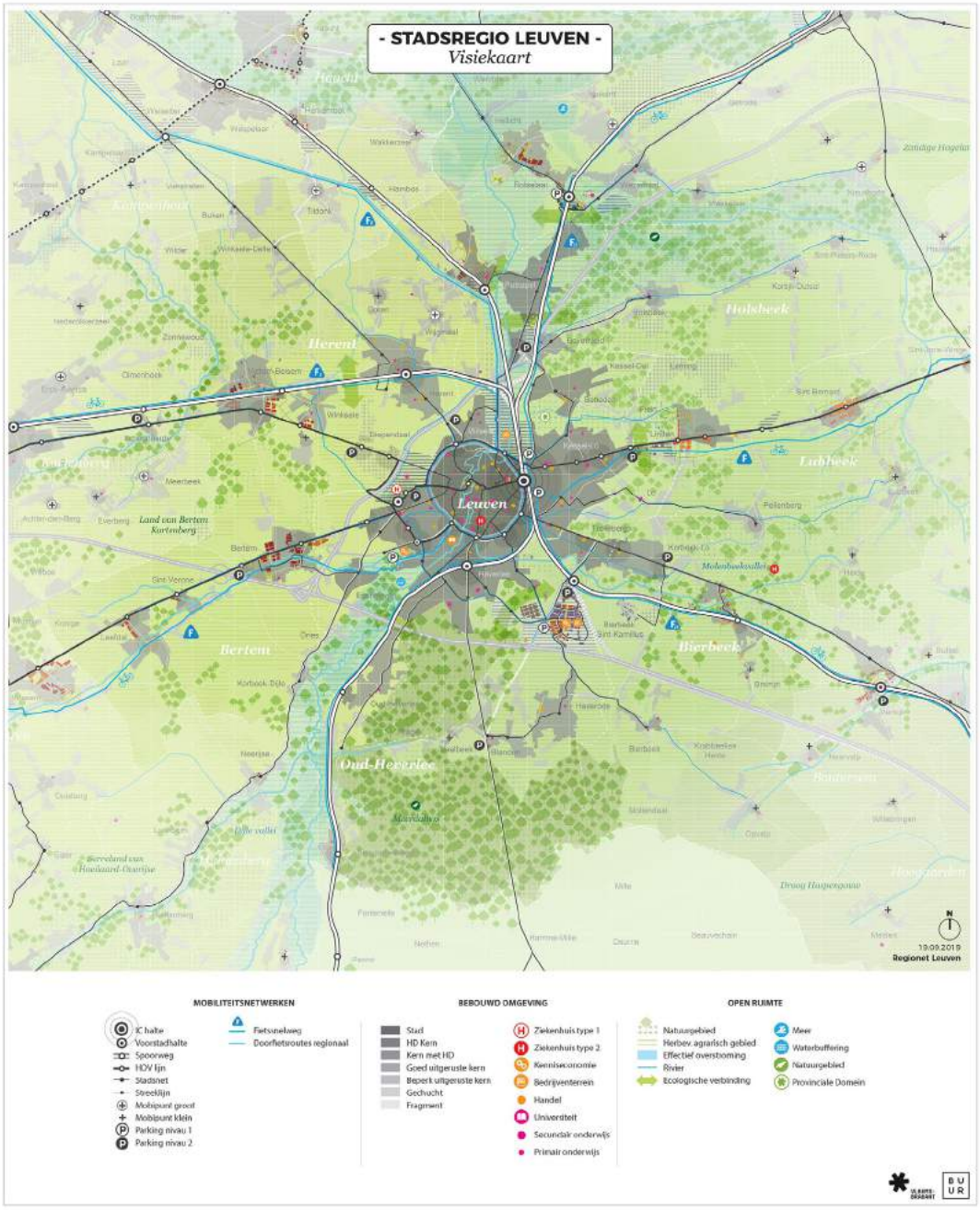

Figure 12: The Regionet Leuven vision has helped to build consensus on the need of a transport oriented regional development of the city-region

Endnotes

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7 Built upon its first Spatial Structure Plan from 2004, that at the time was a pioneer in Flanders Region

8 The Regionet Leuven plan is managed by the intercommunal governance structure Interleuven. The plan has its origin a broad research program that studied the relation between high quality public transport and spatial planning. An English webpage is available at http://buur.be/project-item/regionet-oost-brabant/ (accessed 1 May 2020).

9 The Atlas Renewable Energy is a GIS-based portal that maps the existing and potential renewal energy and potential. Available at http://www.geopunt.be/ (accessed 1 May 2020)

10 A first energy cooperative ECoOB has been founded in 2018 by citizens covering Leuven and municipalities at the eastern side of the city. Citizens are shareholders, investing and getting renewable energy in return. The cooperative finances, delivers and exploits solar panels on major rooftop areas, made available on public buildings.

11 More information on the tool FutureProofedCities is available at https://www.futureproofed.com/future-proofedcities (accessed 1 May 2020)

12 The initiative 'Healthy Clean Cities - Deep Demonstration for Radical Climate Action' is part of Climate-KIC, a private-public partnership supported by developed by the European Institute of Innovation and Technology (EIT), a body of the European Union. More information available at www.climate-kic.org/programmes/deep-demonstrations/healthy-clean-cities/publications/ (accessed 1 May 2020)


ROADMAP 205
KIDS FOR CL

CITY AND REGIONAL PLANNING PRACTICES

Rotterdam Bicycle Vision: Cycling is more than just A to B

Lior Steinberg

The Netherlands is known around the world as cycling heaven. Every first time tourist to the Netherlands faces a scene they probably never witnessed before: endless cyclists are rushing through dense cities using state-of-the-art bike infrastructure to get from A to B. Cycling in the Netherlands is indeed part of the daily life of people, and therefore a core part of the Dutch identity and culture.

But that's not the case everywhere. Rotterdam, the second second-largest city in the Netherlands, is seen by many locals as a car-city. It has the lowest bicycle usage of all the Dutch cities. Amsterdam has a bike mode share of 31%, Utrecht 33%, the Hague 23% - all ranked above Rotterdam, with only 19% modal share (City of Rotterdam, 2019). Even worse, in the southern districts of Rotterdam, below the Nieuwe Maas river, cycling figures in neighborhoods like IJsselmonde, Charlois, and Feijenoord are even gloomier by Dutch standards (City of Rotterdam, 2018).

However, a change is occurring. Thanks to local government efforts - some of which will be detailed below - bicycle use in the Rotterdam has risen in recent years. Between 2016 and 2018, the city has experienced an increase of 13.6% in cycling, and in some neighborhoods, the growth was even sharper (City of Rotterdam, 2019). This success brought some new challenges: bicycle parking scarcity and busy bicycle paths around the city.

This article will describe some of the efforts of Rotterdam to promote cycling in the city as a means for urban change. It will start with a short urban history of the city, followed a discussion of some policies and actions by Rotterdam to promote livable public spaces and active mobility. Then the article will cover the Bicycle Vision of Rotterdam, a document published by the city in 2019. Lastly, the article will present some developments that have happened recently.

The article will focus on two important issues: the promotion of cycling among different social groups, and efforts regarding bicycle parking. I chose to focus on these two issues since they illustrate that cycling is not only about bicycle lanes, but also about supporting infrastructure, and co-working between different stakeholders. While most cities seem to focus mainly on the hard infrastructure, Rotterdam has been taking an innovative approach: looking at cycling as a holistic topic.

Humankind, cofounded by Jorn Wemmenhove and me, has been working the city of Rotterdam on various bicycle and mobility projects, including the Bicycle Vision of Rotterdam. Therefore, I will share a variety of anecdotes from projects we know very well. However, it is essential to mention that the success of Rotterdam is a result of the work of many residents, professionals, activists, organizations, companies, and governmental institutions. I will try to credit involved stakeholders through the process.

MAKE IT HAPPEN MENTALITY

Before World War II, Rotterdam looked like a typical Dutch city: narrow, mixed-use streets, plenty of canals and an extensive tram network. During the war, Rotterdam's historic city center was destroyed and was rebuilt in the 1950s to accommodate car traffic. The result was a Dutch city that resembles North American urbanism: wide streets, heavy vehicle traffic, and noise and air pollution.

While the Amsterdam became a mecca for urbanists seeking to learn how to promote cycling and sustainable mobility, Rotterdam was seen as a car-city. Despite being home to the largest port in Europe, many workers drove out of the city at the end of the workday. The city center was empty at night, and many neighborhoods suffered from negligence and crime rates unknown in

Figure 1: A painting of Rotterdam in 1895, before the Blitz destroyed the historic city centre by James Webb (Public Domain)

Figure 2: Modern post-war Rotterdam (Public domain)

other Dutch cities. For decades, Rotterdam stayed behind the Dutch capital when it comes to livability.

But something changed in Rotterdam in recent years. Since the 1990s, and even more so in the past decade, the city has been heavily investing in livability. Neighborhoods have been densified, streets were redesigned, motor traffic was limited in many places, and the local municipality promoted walking and cycling.

The city motto is "Make it Happen," and this attitude can also be seen in the streets. While most urban planning processes take years or decades to be completed, Rotterdam has been applying a wide range of quick urban interventions to foster change around the city. These actions, known as 'tactical urbanism', include temporary parklets, pop-up parks, and Open Streets events among other things.

One of the most significant tactical urbanism actions by the city was the Happy Streets activity. Happy Streets are temporary interventions that illustrate the possibilities for the future of the street by closed off roads, painting temporary bike lanes, and replacing car parking with other uses, like greenery, seating, and bicycle parking.

Figure 3: Happy streets in Rotterdam (Image credits: Olha Rohulya)

These events and interventions showed residents and stakeholders that a change in a city is possible. It also demonstrated that there is a lot of space in the city, now dedicated to cars, that can be improved and repurposed. The connection between mobility and public space has become vivid: to create a real change, one needs to focus on both.

ROTTERDAM BICYCLE VISION

In 2019, Rotterdam published its Bicycle Vision. The document was developed for the municipality by DRIFT (Dutch Research Institute for Transitions), Humankind (Rotterdam-based agency for urban change), and Studio Bereikbaar (Studio focusing on mobility and accessibility). The main goal of the bicycle vision was to use cycling as a transition tool to improve the quality of life in Rotterdam. Since cycling touches in so many fields (mobility, health, economy, livability), it can be used to take Rotterdam a step further.

The vision in general

The vision for Rotterdam's mobility in 2025 is as follows: the number of trips taken by foot, bicycle or public transportation will be increased drastically, while the number of car journeys will be reduced. Of course, cars will still be used, but an increasing number of them will be emission-free and their speed will be limited. When it comes to cycling, the city wants to have a greater diversity of cyclists, as a reflection of the composition of the population.

The vision focuses on different topics: the creation of small and fast routes, investment in supporting facilities, working with different stakeholders and organizations, and reaching to new target groups. Below, two of the efforts will be described.

Bicycle Parking

One of the identified challenges was insufficient bicycle parking spaces, especially next to the public transport stations. As cycling gets more popular, the lack of bicycle parking is becoming more apparent. However, it is clear that adding many parking spaces is very difficult, especially when the city is getting denser. Therefore, innovation and new solutions were developed.

The Bicycle Vision has come up with the following ideas:

› At both ends of the 'bicycle chain' - origin, route, and destination - bicycle

Figure 4: Bicycle Vision Rotterdam (Illustration by Humankind, agency for urban change)

parking should be optimally facilitated. This applies to residential areas, stations, shops, employment destinations, sports facilities, and others.

- New bicycle parking facilities must meet the demand of Rotterdam's residents. They must be able to handle different types of bicycles (e.g. e-bikes, cargo bikes), and be located at an acceptable distance from destinations. They need to be next to bicycle routes and when not free, should be priced fairly. Parking facilities should look attractive with generous entrances and sufficient capacity for existing and future demand expectations.
- Additional investments and spatial decisions are needed to increase bicycle parking capacity. Also more attention needed to be focused on innovative first and last mile solutions, including shared mobility opportunities.
- The aim is to achieve a good mix of different types of bicycle parking facilities in the city including:
  - Large underground parking facilities
  - Neighborhood parking facilities
  - Small parking facilities in the street
  - Temporary parking facilities
  - Bicycle cages (protected bicycle parking in neighborhoods)
- For destinations such as schools, shopping centers, leisure, sport and culture, the potential of the bicycle is not yet fully utilized. Sufficient quality bicycle parking facilities can make a difference.
- The use of temporary bicycle parking should be further explored. Especially next to events, festivals, and other occasions with peak demands. The city already innovates with the Fietsvlonders (see below) and can expand the program and develop more solutions.
- The city needs to improve research about how shared-bicycles schemes can reduce the pressure on bicycle parking facilities.
- The city needs to better enforce bicycle parking rules, in order to avoid phenomena like "Bicycle Wrecks" (bicycles that were abandoned for a long period).

Related project - Fietsvlonders

A few years ago, Rotterdam city came up with the Fietsvlonders ("Bike-platforms"). These temporary parklets replaced car parking with bicycle parking. They are placed for several months in a neighborhood. If the residents, shop owners, and visitors are satisfied with them after the trial period, the Fietsvlonders are turned into permanent bicycle parking. In just a couple of years, 28 auto parking places in the city center were transformed into 280 shiny parking places for cyclists. At this moment, dozens of locations are being tested and might soon become permanent bicycle parking spaces as well.

Simplicity is what makes the Fietsvlonders so useful. They are not too beautiful or expensive, and they are not the end-goal. They are a quick tool to show people what their street can look like, a real-life render if you'd like. They are part of Rotterdam's long-term agenda to become a people-friendly city.

Figure 5 (top): Parking in Rotterdam (Illustration by Humankind, agency for urban change)

Figure 6 (bottom): Fietsvlonder in Rotterdam (Image credits: Lior Steinberg)

Rotterdam Bicycle Alliance

As mentioned above, the Bicycle Vision didn't deal only with physical aspects. The focus on co-working between different stakeholders in the city is crucial for the development of Rotterdam as a livable, bicycle-friendly city. The goal is to strengthen the cooperation between parties who want to encourage cycling with the creation of the Rotterdam Bicycle Alliance: a collaboration that aims to further develop the bicycle culture in the city and to get more urbanites to cycle safely. This will be done by sharing knowledge, experiences, and activities.

The Bicycle Alliance will also include parties such as the municipality (mobility, health, education, and sports departments), Port of Rotterdam Authority, The Dutch Cyclists' Union (Fietsersbond), developers, architects, large and small companies, entrepreneurs, welfare parties, sports associations, cultural institutions, schools, event organizations, bicycle couriers, and so on. The whole is greater than the sum of its parts. The task is to involve as many parties and organizations as possible. Only by working jointly and decisively can the desired mobility transition be achieved. This also applies to different departments within the municipality, where co-working can be sometimes a challenge.

Building blocks for the Rotterdam Bicycle Alliance:

- The cooperation between the various parties and organizations is based on a joint vision, where activities and uses of resources are coordinated. For this to work, the municipality has to take the lead role.
- The municipality has already started driving the mobility transition, together with other parties. The 2016-2018 Bicycle Plan, for example, was drawn up with input from residents and translated into concrete actions. Some collaborations have already been successful, like the Fietsen op Zuid program (see below). The idea is to spread them around the city.
- The Bicycle Alliance can also play a role in neighborhood developments, social programs, tourism, cultural events, and sports.
- The Bicycle Alliance should seek to work with local influencers: people who are important for specific target groups.
- To further stimulate cycling in Rotterdam, the city needs to develop a brand that appeals to a wide target group. This brand can be developed together with the partners in the alliance, as they know the different target groups. The partners can also spread the materials and information to their target groups.

Related Project - Fietsen op Zuid

In a country built for the bicycle, less cycling means limited cultural and occupational opportunities, higher transport costs, possible barriers to meeting with friends and family, lower rates of physical activity and a higher chance of obesity. Still some neighborhoods in Rotterdam have low cycling usage by Dutch standards.

Some of the reasons for the low bicycle use in these areas are car-oriented infrastructure, a negative social perception of bike riding, lack of bicycle ownership, and people - particularly with a migrant background - who don't know how to cycle. Many low biking areas are also home to some of the poorest communities in the Netherlands (City of Rotterdam, 2017).

To tackle these challenges, the city launched the 'Fietsen op Zuid' ('Cycling in the South') program. It was initiated in 2016 by DRIFT (Dutch Research Institute for Transitions), Humankind (Rotterdam-based agency for urban change), and the Dutch Cyclist' Union, and funded by and in collaboration with the municipality of Rotterdam.

The program aims to promote cycling as a means for the social-economic

Figure 7: Teaching children to use and repair the bicycle (Image credits: Jorn Wemmenhove, Humankind)

development of Rotterdam South. Fietsen op Zuid's holistic approach addresses four aspects for successful promotion of biking: lifestyle; education; access to bikes; infrastructure and public space.

Over the years, the program implemented projects and pilots to promote efforts ranging from urban interventions through social programs to meetups between residents. In order to truly create a sustainable change, Fietsen op Zuid brings together local organizations and networks to work together including : the municipality's public health department, schools, a mosque, a women empowerment organization, local media, and businesses.

Two of the projects carried out are described below.

Cycle Along ('Fiets Mee')

Developed together with the local organization 'Sezer voor Diversiteit', this project is aimed at promoting bicycle use among women in Rotterdam, especially among women from a bicultural background. The approach includes cycling lessons for hundreds of women and the set-up of a special ambassador's network.

The network of ambassadors and trainers is especially important: local women are becoming teachers to other women in the area. This was the key to build an expanding network of women who learn to cycle. It also removes the barrier of prospective participants, as the barrier to entry is low.

The project stimulates women and their families to use bikes instead of cars or public transport. Not only are the participants empowered, but they are also able to live a healthier lifestyle and extend their social and economic networks.

Bike-friendly Schools

Children - and their parents - need to get to school daily. Unfortunately, we encountered the fact that many of them use the car, although the distance from their home to the school is not large.

In order to make cycling more appealing, Fietsen op Zuid has worked on creating bike and pedestrian friendly school areas. It has been providing school classes, refurbishing bicycles for kids from families that cannot afford them, and redesigning the schoolyard and the public space around schools using tactical urbanism.

This approach upgraded physical elements around schools and to raise awareness to a healthy lifestyle. The solution is not to patronize but create a dialogue with the children and their parents and understand why they choose the car over the bicycle. In the end, by creating the habit of cycling to school, we can promote cycling for generations to come.

SUMMARY

One of the important lessons from Rotterdam's experience is that are complex challenges require holistic solutions. Promoting cycling is not merely an issue for mobility departments. Cities need to focus on the social and economic benefits of cycling, and a broad range of actors in the promotion of cycling.

Moreover, the Bicycle Vision and its complementary projects show that working together with local actors is the path to success. The existing local networks create the bridges much needed for sustainable change.

I hope that these projects will inspire cities to focus on mobility as an empowering force. When all of us realize that cycling is not only a means to get from A to B, but a tool for promoting the health, economy, and social values of the community, we can create better cities together.

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Figure 8: Replacing car parking spaces with seating and green around schools. Using PRKLT, a modular parklet, we applied tactical urbanism to transform school environments (Image credits: Humankind)

Regenerative Urbanism:
Using the New Capital of Indonesia to Restore the Forests of Kalimantan

Dushko Bogunovich, Felicia Atmadja, Natalia Titisari

INTRODUCTION

In August 2019 the President of the Republic of Indonesia announced a plan to move the nation's capital from Jakarta. The decision was mainly driven by several facts. First, Jakarta is slowly sinking, due to both sea level rise and widespread underground water pumping. Second, the metropolitan region, with its almost 30 million inhabitants, is struggling with transport and other infrastructure shortfalls. The decision was also justified as an effort to relocate the new national capital to the center of the over 3,000 km long country and thus stimulate a more geographically balanced and inclusive economic development of the nation.

Based on their initial feasibility study, the government selected the location for the New Capital City (NCC) in the East Kalimantan province, on a site partly sitting in the North Penajam Paser Regency and partly in the Kutai Kertanegara Regency. Within this 200,000 hectare area the construction of a world-class sustainable city was planned to start within five years following the August 2019 announcement.

With such a high level political, economic and environmental agenda, the government decided to consider both existing internally prepared design concepts for the future capital and to consult overseas planners, engineers, architects and other qualifying professional and academics. An international competition was announced in October 2019, with the brief calling for a smart, green, modern 'forest city', with a strong formal expression of national identity.

The significance of Indonesia's NCC project thus radiates beyond the national boundaries. This project could demonstrate that in many other instances on this rapidly urbanising planet, not only in Indonesia, booming cities could be harnessed to bring substantial benefits to the global ecosystem. They just need to go one step beyond the conventional 'sustainable city' formula based on 'minimising the ecological costs and instead aim at 'maximising the ecological benefits' (Thomson & Newman, 2016).

Figure 1: The location for the new capital city (NCC) of Indonesia
Source: (Maulia, 2019)

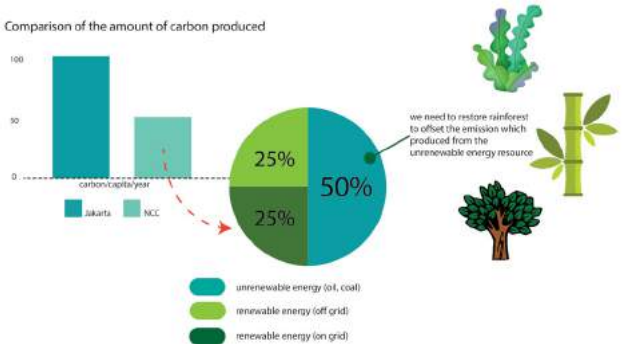


Figure 2: The principle of carbon off-set
Source: Authors' diagram

The winning entry, named *Ngara Rimba Nusa ("Forest and Island Hilltop")*, was announced in late December, 2019 [1] [2].

While our proposal was not selected, in this article we aim to show that our approach offers a formula for ecological restoration – using growing cities as its principal driver – worldwide**.** With the global climate crisis simmering in the background, it should be imperative to restore the world's forests as carbon sinks.

THE MASTER PLAN CONCEPT

We took up the Indonesian NCC challenge and after a rather short period of time (four weeks) given by the competition organiser, and along with 755 other competitors, submitted our entry in time. In our proposal we took the position that the future city should *maximise the environmental benefits* rather than just *minimise the environmental costs*. This lead to our design concept being based on the concept of 'regenerative city' – the idea that a city can produce positive, regenerative impacts on the natural environment, not just minimize its negative impacts.

Our approach translated to our central proposition that *NCC's construction and operation are conditional upon restoring a significant portion of the forest ecosystems of Kalimantan* which have been destroyed over the past 30 years, mainly by farming and mining, and fires. In other words, we responded to the competition brief with a suggestion that this nationally important project should be about restoring the legendary Borneo tropical forest – a severely endangered national and international treasure (Fig.3) – as well as about building the new national capital.

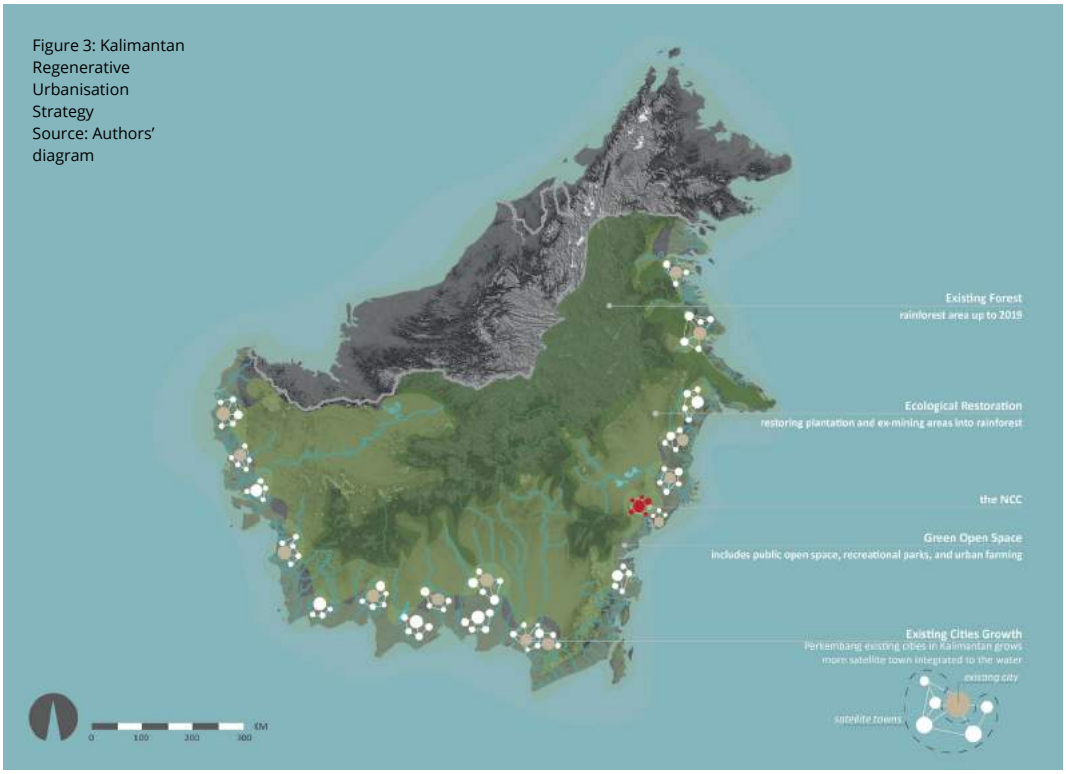
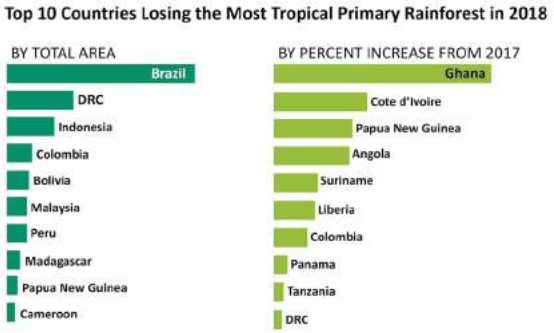


Figure 3: Kalimantan Regenerative Urbanisation Strategy
Source: Authors' diagram



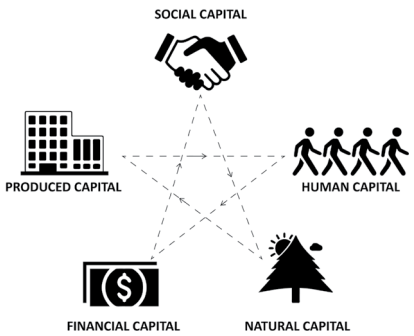


Figure 4 (left): Top 10 Countries Losing the Most Tropical Primary Rainforest in 2018
Source: World Resources Institute, 2018

Figure 5 (right): Five capitals of regenerative development
Source (Mang, et al., 2016)

This fundamental principle was then developed into a master plan concept with the help of five design-generating propositions, themselves derived from five types of capital in regenerative development (Fig.4). These multiple forms of capital are the actualisation of stakeholder systems that creates a co-evolving mutualism needed for maintaining the regenerative effects of urban development (Mang, et al., 2016).

The first capital of regenerative development is the *social capital*. It is the capacity to foster cooperation, trust and mutual benefit among interdependence communities to achieve collective goals.

The second capital of regenerative development is *human capital*. It is the health and capacity of communities which can be developed through education, training, and experience (Mang, et al., 2016).

The third capital of regenerative development is the *financial capital* which means the money invested to provide goods and services to produce other forms of capital return.

The fourth capital of regenerative development is the *production capital* which includes assets such as buildings, city infrastructures, and natural resources that enable development.

The last capital of the regenerative development is the *natural capital* composing the web of living systems that generate, provide sustenance for, and enable the evolution of life.

In the NCC regenerative urbanisation project, this capital is translated into the process of *city metabolism*. The NCC became the prototype of city devel-

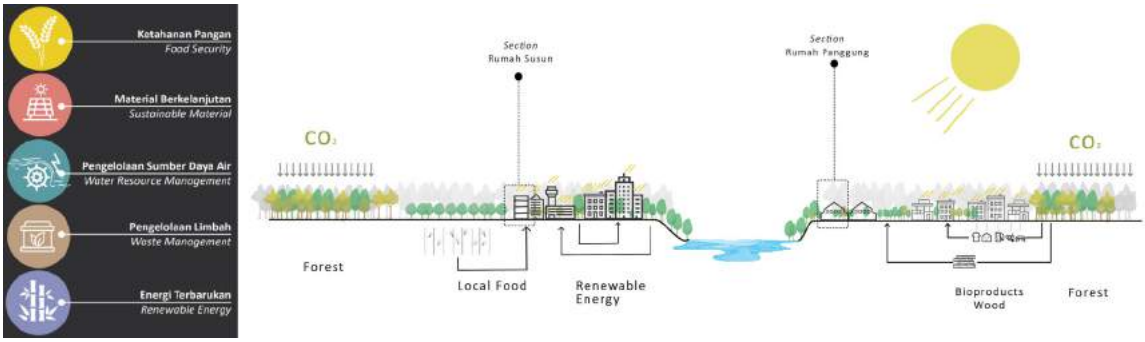


Figure 6: City Metabolism System of NCC
Source: Authors' diagram

Figure 7 (top): Curitiba as the world's leading model of ecological urbanism
Source: (Mang, et al., 2016)

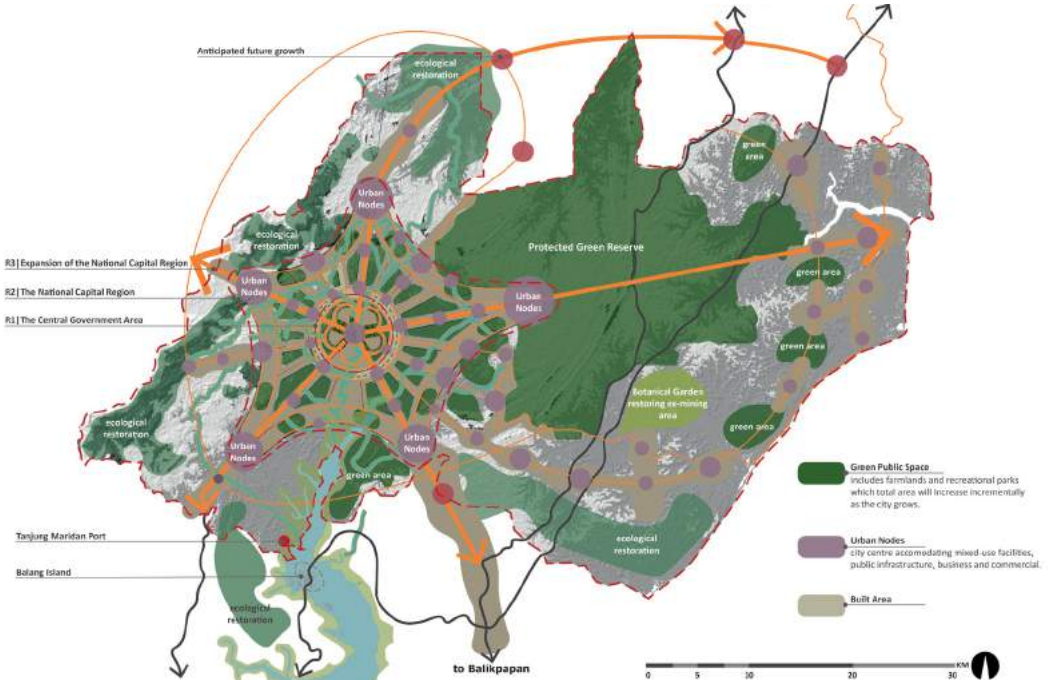
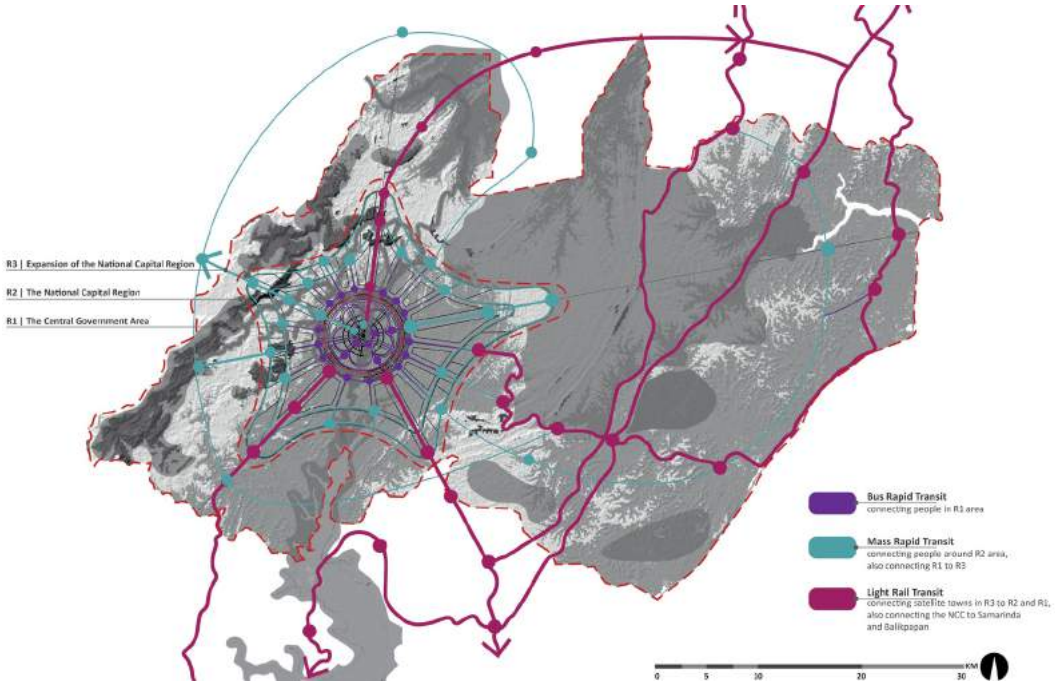


Figure 8 (bottom):
NCC Land Use Map
Source: Authors' diagram



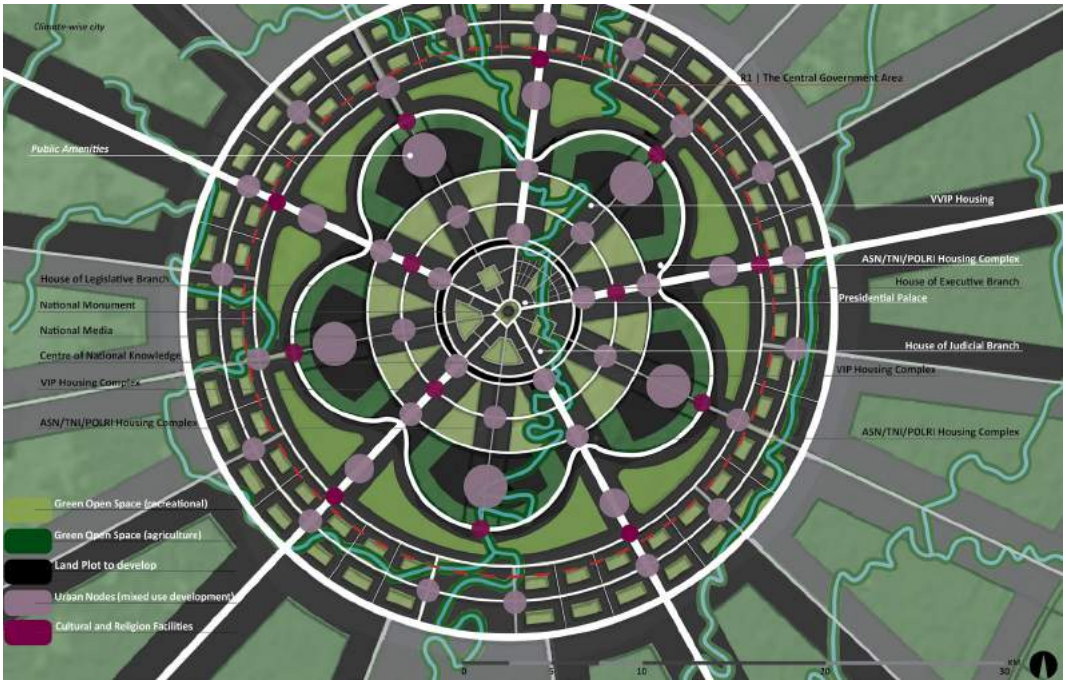


Figure 9 (top): NCC Public Transport System
Source: Authors' diagram

Figure 10 (bottom): Government Precinct (R1) Master Plan
Source: Authors' diagram

opment which is driven by five key components of the city's metabolic system: renewable energy, food security, water resource management, sustainable materials and waste management. These five streams, working independently as well as in an integrated manner (e.g. solar energy powering the wastewater system, at the end of which the solids are converted into construction material), should operate at a necessary minimum to achieve a harmonious coupling of the 'smart city' and 'green city' models (Thomson, 2018).

The *Smart City* concept is about deploying 'green-telligence' to reduce demand and optimize the use of all resources, then minimise and absorb all waste. A city with a reduced aggregate metabolism is a city which offers a better quality of life and has a more realistic prospect of off-setting its carbon and water footprints. The *Green City* concept is about using the 'ecological services' of the 'green infrastructure'. This means actively using natural systems – weather, waterways, soils and vegetation – in and near the city to lighten the load of conventional 'grey infrastructure'. The NCC will be a global model of a 'Smart Green City-Region'. As the net carbon sink, it will have a proven record of positive carbon balance and will contribute to stabilising the world's climate and reversing the global biodiversity loss.

Our design for the NCC was influenced by that of Curitiba, Brazil as one of the leading cities for ecological urban development. Its master plan envisages a generous amount of green open space, functioning as green infrastructure. In Curitiba, the amount of green space in the city has increased incrementally during the last 30 years, resulting in nearly 1/5 of the city being the green area. The city's government also acquired lands along the city's river to create linear parks to maintain the riparian ecosystem as well as provide connection between the urban nodes as an alternative transportation corridor (Mang, et al., 2016).

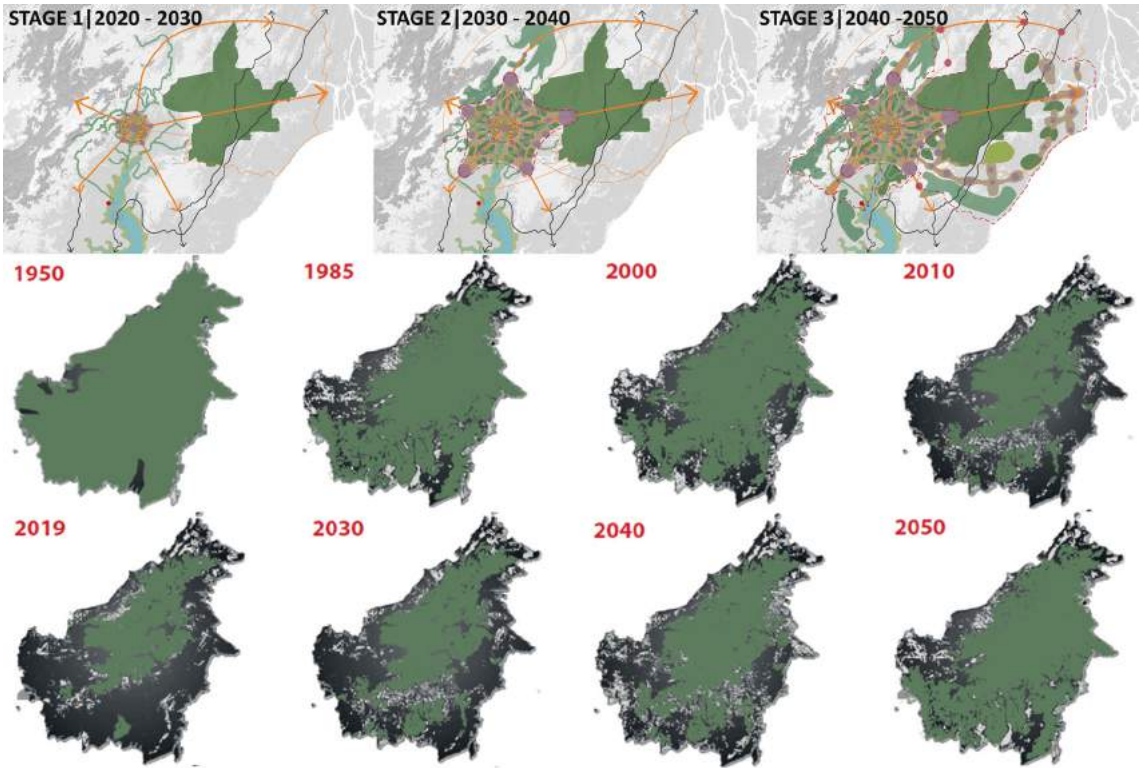


Figure 11: Staging Plan and Kalimantan Rainforest Regeneration
Source: Authors' diagram

The exact layout of the green network would be determined using an accurate GIS data base, while following the *land suitability analysis* method made famous 50 years ago in the book *Design with Nature* (McHarg, 1959).

We proposed a star-shaped NCC master plan, with the centre accommodating the 'five powers' of the national government, and five axes of high-density development radiating out from that centre. Between the five axes are green wedges of open space, with occasional satellite town/village development in them at some distance from the city centre.

Looking at the whole region, the master plan will have a total sum of 60:40 ratio of green and built areas (Fig.15). The green areas are also divided into three different types in a befitting manner towards the local culture including (1) urban farm land, supporting the NCC's permaculture system, (2) recreational parks acquired by restoring the ex-mining area into botanical gardens and linear parks within the dense built area, and (3) protected reserve which are part of the regional ecological restoration effort.

Again looking at Curitiba city's fabric, we adopted its linear city principle manifested in structural arteries servicing densely populated built areas as public transport corridors. In Curitiba this design resulted in around 30% decline in auto traffic since 1974 despite the city's population doubled growth. Curitiba's public transportation is effective, fast and able to carry more passengers per weekday than New York City's public transport systems (Mang, et al., 2016).

The inclusion of a public transportation system is a fundamental part of regenerative urban development in order to make cities 'carbon-positive'. We proposed a NCC public transport system with three layers of connection: (1) local connection using bus rapid transit (BRT); (2) regional connection using mass rapid transit (MRT); and (3) macro-regional connections using light-rail transit (LRT). Supporting the main purpose of a 'carbon-positive' city, the master plan encourages a strict rule of no-cars in the governmental precinct area by optimising the use of BRT, walking and cycling.

The regenerative development of NCC and its 'followers' – the other cities and towns of Kalimantan – is divided into three construction stages during a 30 year timeline, with its ultimate goal to build cities in the manner which grows the forest back. The first ten years are focused on the construction of the core government precinct and the infrastructure of bus rapid transit. The second stage is about the construction of the metropolitan district, building more mixed-uses and public facilities integrated with the mass rapid transit. In the last stage, more satellite towns start to emerge along five growth corridors accompanied by the light rail transit infrastructure and ecological restoration. We envision that, by 2050, the Kalimantan rainforest would be restored approximately close to its extent in 1985. This process will happen incrementally, as the NCC and other regional urban clusters on the island emerge and grow.

THE METABOLISM OF THE NCC

Urban metabolism (UM) is a concept with a long history in urban ecology and urban planning. (Grimm et al. 2008). This theoretical model perceives cities as quasi-organic systems which have input (resources) and output (waste) as a constant flow of quantities. Ideally, the volumes and rates of these flows can be monitored, measured and managed. According to Kennedy et al. (2007), urban metabolism has four fundamental flows to be explored and monitored – water, materials, energy and nutrients. Cities use these flows to transform and support their population and activities every day. The scale of the city de-

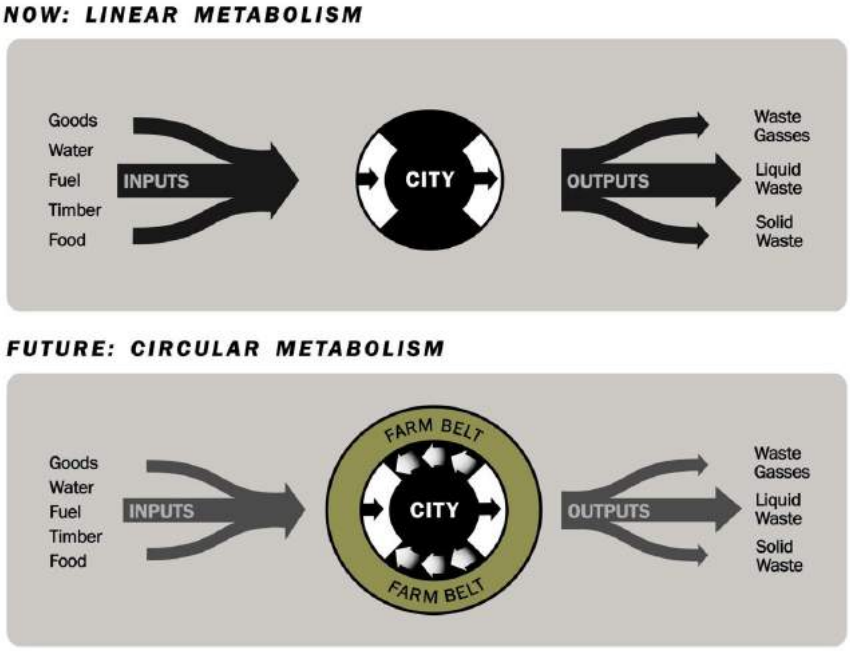


Figure 12 (top): Circular Metabolism System
Source: (Lehmann, 2010)

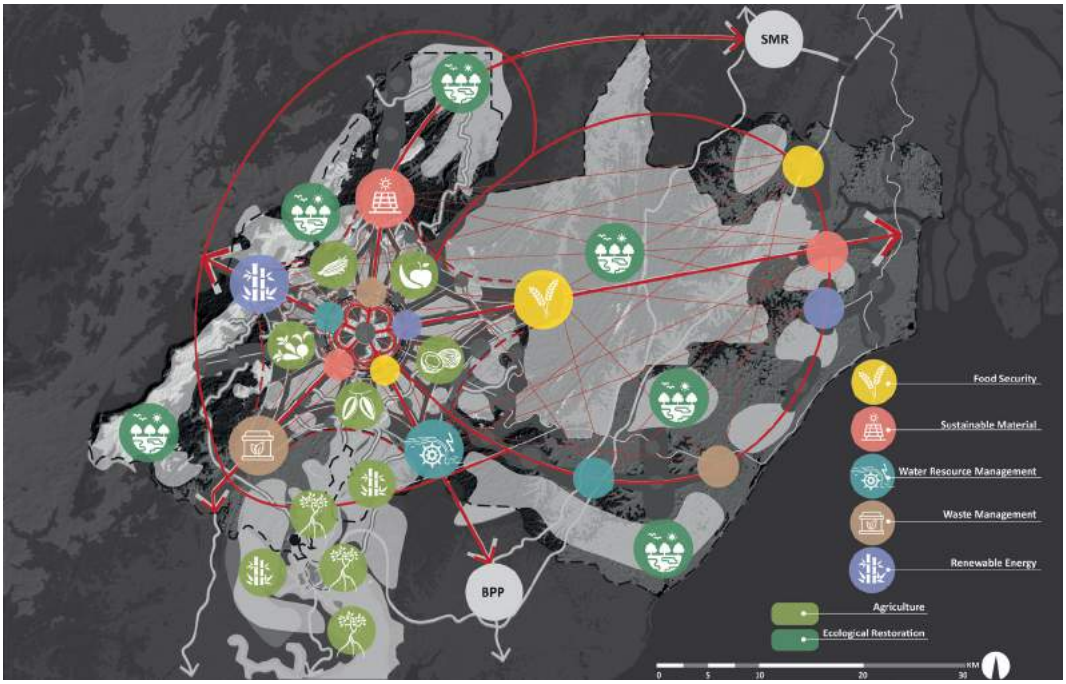


Figure 13 (bottom): NCC Urban Metabolism System
Source: Authors' diagram

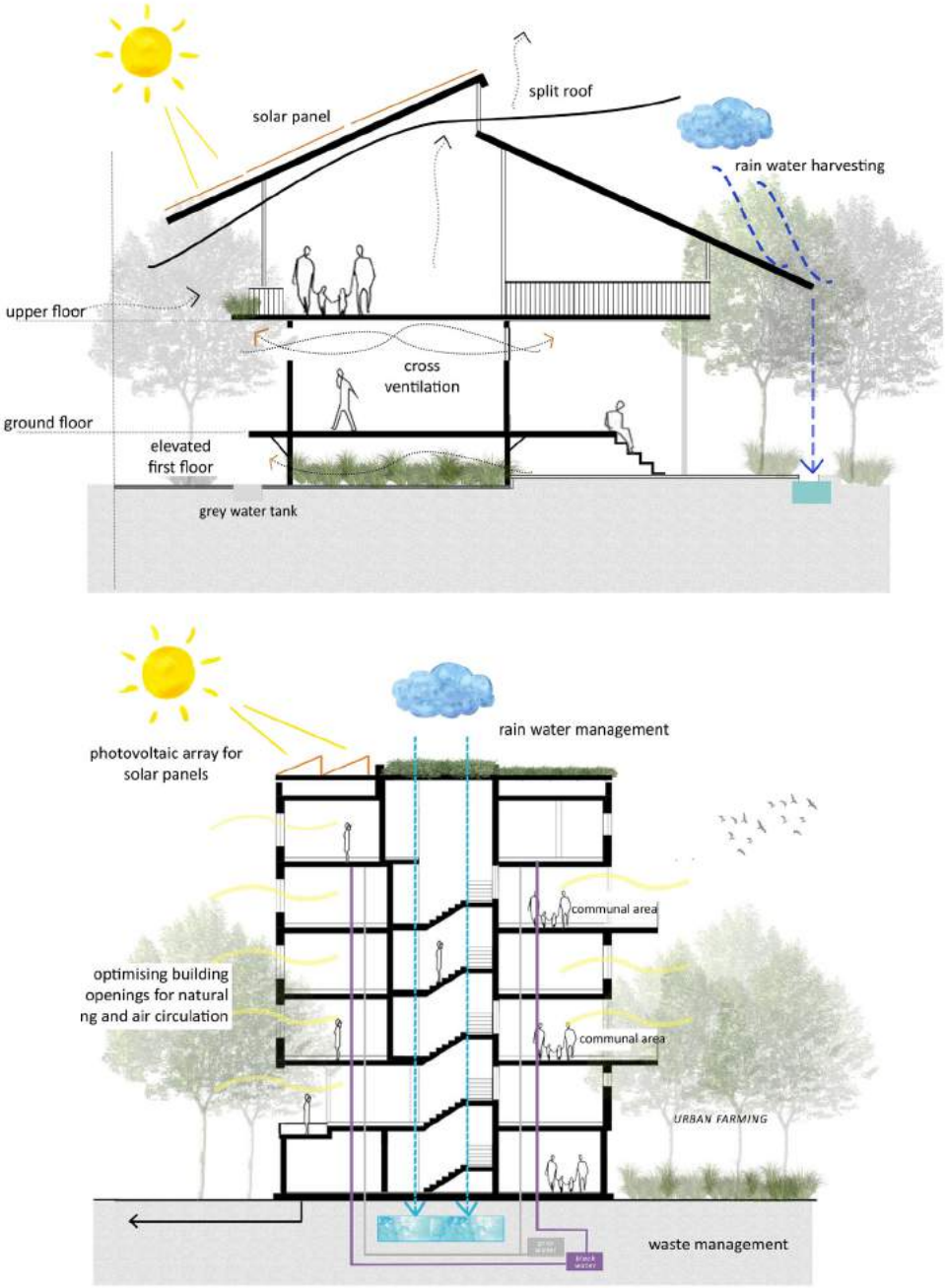


Figure 14: Passive Design Principles for housing
Source: Authors' diagram

termines the requirement for the input of resources which ultimately affects the environmental loading. To ensure the loading is within the carrying capacity of the surrounding ecosystem, we must measure and regulate the volume and rate of UM.

We must also distinguish the linear and circular flows of inputs and outputs (Fig.21). Circular flows – usually referred to as 'loops' – are preferred over the linear flows because they indicate self-sufficiency. The ability of the city to treat the 'waste' of some of its processes as a (recyclable) 'resource' for some other processes increases its security and reduces its loading on the environment.

In an ideal planning and management situation, we would strive to calculate the total circulation of resources (input) and wastes (output) in the city, and then use the data to minimise and re-loop the flows as much as possible, aiming at a balance between the city as a 'parasite' and the supporting ecosystem as the 'host'. Information on this interaction is thus important. When comprehensive, reliable and accurate information is available and used, it enables 'intelligent' functioning of the city. In other words, its metabolism qualifies as 'smart' (Bogunovich, 2002) and only then the popular idea of 'smart city' becomes meaningful.

The NCC development agenda in Kalimantan also is of global interest since it is located in the second largest island in Indonesia and one of the largest in the world. The future UM of the NCC will affect the natural ecological metabolism of Borneo/Kalimantan, and that cannot but have consequences for the entire planet. The island is one of the "three lungs of the Earth" places where the abundant tropical rainforest supports and regulates oxygen on a global scale. This 'lung' is now badly damaged (just like the other two 'lungs', the Amazon and the Congo basins), so NCC planning offers a rare opportunity to consider an approach beyond the 'good' urban planning which only minimises the carbon footprint of a city.

The UM of the future city must indeed be reduced in volume, and circular in principle, as much as possible. With modern technology, especially information and communication technology (ICT), the desired super-efficiencies in the resource consumption and resource generation are possible. But beyond that, the city must rely on off-setting remaining, unavoidable impacts if it is to be 'carbon-negative' or at least 'carbon-neutral'.[3] Eventually, the master plan of the super-efficient, resource-conserving city must be accompanied with an ecological protection and restoration plan for a wider area, to retain and, over time, to enlarge the natural carbon sinks and biodiversity in its surroundings.[4]

In our regenerative development scheme, the UM of the NCC consists of five pillars of productivity and security: (1) renewable energy, (2) food security, (3) water resource management, (4) sustainable materials procurement, and (5) waste management. These are the five elements of UM which have to be subject to control, regulation and optimisation. The aim of this 'green-telligent' intervention is to *reduce the demand* via eco-efficiency, and *secure the supply* via eco-sufficiency.

Our master plan has five Urban Metabolism Hubs. Each hub becomes the centre facility co-ordinating the servicing of the whole city via suburban and neighbourhood scale facilities. To ensure the success of the circular city metabolism, the five activities must be carried out into the smallest scale at household level. For example, every household in the NCC should be:

- Optimising green space in their housing area for planting edible plants.
- Separating waste before it is circulated to the district level and acquiring a compost bin to process their own kitchen waste.

- Installing rainwater harvesting system, recycling grey water, and preparing large portion of water catchment area in their green space.
- Installing solar panels (heat and power) in their roof to support the minimum needs of electricity.
- Using as much as possible renewable and sustainable materials – timber primarily – for construction which is also be included in the building permit.

When all the key aspects are already put in place at the lowest spatial level of the city – the household, or a workplace – the combined benefits accumulate through the whole urban metabolic system. Maintaining a moderate volume, and mainly circular flow, of inputs and outputs in all five strategic consumption areas, makes the task of off-setting the unavoidable ecological footprint (by regenerating the native forests and wetlands) more realistic. It also enables the speed of the eco-restoration to be in step with the speed of the NCC's growth.

However, this is not possible without considering a much wider geographical area than the territory designated by the government for the physical development of the NCC. A region-wide approach is imperative if the NCC is to be a carbon-negative city.

We estimate that the NCC – along with similar re-alignment of all future growth in the neighbouring cities of Samarinda and Balikpapan – would require a series of forest regeneration projects over the entire province of East Kalimantan.

Looking at an even larger scale, we have proposed that all other cities and towns in Kalimantan be involved in this grand, island-wide regenerative project. All existing and future urban development in all five Kalimantan provinces need to mimic the UM of the NCC, which serves as a beacon of the 'right practice'. All urban settlements in Kalimantan should form clusters modelled on the 'East Kalimantan trio' – Samarinda, Balikpapan and the Capital City – and draw plans to restore natural habitat in their local and regional areas. In this manner, over some 30 years, they will grow back their own carbon sinks and thus create their own off-setting capacity.

Thus the core principle is the rigorous control of the UM of the NCC, and then balancing the remaining, inevitable 'entropic surplus' of the new city with the help of the regenerated forests in the wider region. This is the only way to achieve the first 'neg-entropic' city in history, and with it establish Indonesia as the global leader in Regenerative Urbanisation.

DISCUSSION: THE PROMISE OF REGENERATIVE URBANISM

Our proposal shows how it might be possible for a new or growing city to make the surrounding nature better off, rather than worse off. Regenerative urbanism is also a case for *Ecologically Positive Urbanisation (EPU)*[5] – building cities which grow forests. The case for a 'good urbanisation' is extremely important in a world where more than 50% of all people live in cities, which consume 75% of all resources and generate 75% of all waste.

'Regenerative urbanism' means that the growth of the NCC must be 'off-set' (Fig.2) by restoring some of the once-enormous tropical and subtropical forest of Kalimantan. The carbon emissions generated by the NCC must be neutralised – and eventually 'over-compensated' – by the carbon sinks of the re-instated forests in the East Kalimantan province.

This principle that the ecological impact of urban growth from now on must be off-set by reforestation applies to the rest of the island. All new cities and towns, and all future expansion of the existing cities and towns in

Kalimantan, must be conditional upon restoring the forest carbon sinks and boosting biodiversity in their local regions. Our master concept envisages a dozen or more of clusters of cities with their satellite towns (Fig. 10) which are in sum 'carbon-negative' or at least 'carbon-neutral'. Together, they should be able to restore about 100,000 square kilometres of forest over the next 30 years (2020-2050).

This model must be physically demonstrated, not just theorised. Regardless of the current focus on the physical plan for the new city, the Republic of Indonesia's decision to build a new national capital is a rare opportunity to demonstrate the principles of EPU at a major urban and regional scale, and amidst one of the most ecologically degraded areas on Earth. The scale and pace of the ecological devastation of Borneo has been a matter of international concern for many years. However, it must be acknowledged that reversing the damage would be a very costly exercise. The global significance of the tropical forests of Borneo offers Indonesia a chance to seek international assistance. Presenting to the potential donors a clear idea of how this can be done, strengthens the case.

The Government would indeed have a strong case at the world stage, since the idea of the Regenerative City now has considerable international recognition[6] and following[7]. It is well established in theory (Girardet, 2010 & 2015; Zari, 2018; Axinte, 2019), and to some degree in practice (Hand, 2017; Fayed & Rashid, 2019), that this approach to the global climate action is imperative, effective and feasible.

Our competition entry shows that the truly 'sustainable city' conundrum has been solved. At its core lies the concept of 'regeneration'. Regeneration is about mimicking what living nature does all the time in its cosmic battle against entropy: it uses the information to achieve ever higher levels of the organisation. While this makes sense to a scientist, this may feel like a foreign language to a city planner, or an urban designer.

Arguably, a different jargon is needed and possible. To use the language of urban design and city planning, 'regeneration' is essentially about a harmony between Form and Function.

In our case, the Form is embodied in the proposed Master Plan for the capital city; the Function is manifested in the prescribed Urban Metabolism. On another site, with a different climate and topography, and different political and popular culture, both the master plan concept and the urban metabolism synopsis would have looked different. But that is of marginal importance, since what really matters is the essential message: you do not get a 'forest city' by mimicking real forest in the urban design of that city, or even cultivating real forest groves in the city, but by (re)establishing real forest in the surrounding region. This has to be done at a regional scale which keeps ahead of the city's volume of UM and stays above the size of its ecological footprint.

Only at the regional scale can true urban sustainability and resilience be achieved.

CONCLUSION: NCC IS ABOUT KALIMANTAN

The NCC project has global significance. Along with the forests of the Amazon and Congo basins, the Indonesian forests of Kalimantan, Sumatra and Irian-Jaya are one of world's three most important forested regions. For a good reason, they have been called the "three lungs of the planet"[8] – a powerful reference to their function as carbon sinks and sources of oxygen, without which the abundance of life on Earth would not be possible.

In these times of dire and urgent global climate and biodiversity crises, it

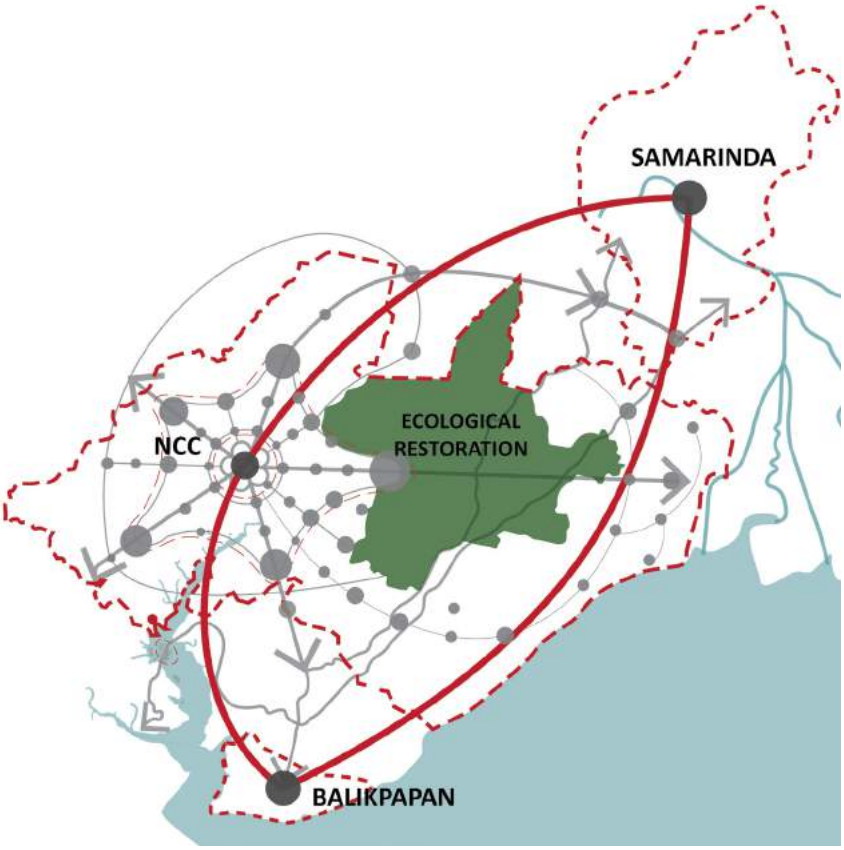


Figure 15: The NCC as the prototype of regenerative urbanism
Source: Authors' diagram

is no exaggeration to state that human survival depends on the three 'green lungs' of the planet like never before.

In summary then, if the NCC project is conceived, promoted and implemented as a demonstration of Regenerative Urbanism – or, an experiment in *Ecologically Positive Urbanisation* – it would enable the Government of Indonesia to do three things:

1. Respond to the scepticism in the international community that moving the capital from Jakarta to Kalimantan will not cause even more damage to Kalimantan, after decades of well-publicised forest devastation;
2. Seek substantial international technical and financial assistance for the NCC project, since Borneo/Kalimantan is widely recognised as a vital global carbon sink;
3. Face the global community as a modern, progressive, ecologically-conscious nation, which understands its international responsibilities and will act accordingly – but also demands fairness in sharing the burden of healing the planet.

To ensure the success of this demonstration, the global community should respond and offer collaboration, technical and financial assistance. One could think of a long list of nations and organisations [9] which should take part in this opportunity to demonstrate global solidarity in the common battle against the looming climate catastrophe.

ENDNOTES

1 https://www.thejakartapost.com/news/2019/12/26/nagara-rimba-nusa-announced-winner-new-capital-city-design-contest.html

2 https://www.straitstimes.com/asia/se-asia/indonesian-govt-picks-winner-of-design-for-new-capital-city-in-east-kalimantan

3 There is some confusion in the literature around the use of the terms 'carbon-neutral', 'carbon-positive' and 'carbon-negative'. The word 'positive' usually means something good, so some authors use the expression 'carbon-positive' to denote an entity which stores CO2, i.e. functions as a sink. But since CO2 ('carbon') is a 'bad' substance in this context, we side with those authors who choose to call carbon removing systems – 'carbon-negative'.

4 To avoid any misunderstanding, in no way are we advocating that 'carbon offsetting' is a panacea, and that if we 'plant enough trees', we can go on with polluting as before. At the global scale, humanity's carbon-addiction can only be resolved with a parallel action on reducing combustion and GHG emissions, and sequestering the past, and any future, carbon emissions by restoring the natural carbon sinks in oceans, soil and vegetation. See discussion here: https://www.maxfordham.com/mf-net-zero/carbon-offsetting---friend-or-foe

5 References to the expression Ecologically Positive Urbanisation appear impossible to find in the academic literature. However, the discussion of is lively in various corners of the world, in most cases in the business and professional communities rather than academia. For example: https://www.eco-business.com/opinion/urbanisation-can-be-good-for-the-environment/

6 Wikipedia: Regenerative City. https://en.wikipedia.org/wiki/Regenerative_city

7 Medium: S. Surig. https://medium.com/thebeammagazine/regenerative-cities-an-urban-concept-whose-time-has-come-e08b5271ccf8

8 Arief Rabik, of the Bamboo Foundation, describes (p.12) "Indonesia as one of the three lungs of the world" in: https://www.churchilltrust.com.au/media/fellows/Long_J_2016_Treatment_methods_to_develop_Australias_bamboo_industry.pdf

9 Some of the international institutions and other entities which could, or might, or should support this project, whether in finance, kind or expertise, are listed here:
UNDP, UNEP, UNESCO and UN-Habitat
The World Bank
Asian Development Bank
Asian Infrastructure Investment Bank
Belt and Road Initiative (China)
Partnership for Quality Infrastructure (Japan)
ASEAN and APEC
The European Union
The Commonwealth of Australia
Governments of China and India
The governments of Malaysia and Singapore
The Government of Netherlands

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Planning for Inclusive Economic Regional Development in Climate Change Vulnerable Provinces of Nepal

Pasquale Capizzi, Darren Gill

ARUP has worked in Nepal since 1976 on a variety of infrastructure and planning projects. Between 2018 and 2020, we worked with two recently established provincial authorities of Nepal to formulate their development plans. This article describes the journey we have taken to support these authorities in developing forward-looking, evidence-based plans for development in the context of climate change.

In 2018 the Economic Policy Incubator (EPI) program in Nepal invited proposals for providing technical and strategic support to selected provincial authorities in the formulation of their provincial economic development plans. EPI is sponsored and overseen by Nepal's Ministry of Finance and funded by the U.K. Department for International Development (DFID) and implementation is led by the Palladium Group. The study area included the mountainous *Karnali Province* (also known as Province Six) to the north-west, and the yet to be named *Province Two*, a mostly flat and fertile expanse to the south-east of the country. The main objective of the demand driven program is to support the Government of Nepal (GoN) to develop better policies in order to attract investment, create quality jobs and achieve higher and sustainable and inclusive economic growth.

Our response highlighted that sustainable and inclusive economic growth at the regional scale must be rooted in the reality of the territory today and look forward to the future imposed by climate change, especially in the Hindu Kush Himalaya. Our approach insisted that, firstly, sectoral development activities or financial and tax incentives, such as Special Economic Zones, should be as financially viable and economically productive as they are spatially relevant and in touch with the social reality of the ground. Secondly, while endowed with unique landscapes and ecosystems, Nepal is also amongst the most vulnerable countries in the world to the effects of climate change. Therefore, its prospective wealth is largely dependent on the health of its environmental resources.

In essence, a practical plan should be a balancing act between the strengths of the territory, the ambitions of administrations and the people, and a sense of what projected changes in climate and environment may imply for economic and productive activities.

Entrusted with this work, we immediately set out to establish a robust spatial baseline of two provinces in Nepal in 2019 and contrast this with expected changes by 2050, in collaboration with Palladium. Our team was composed of international and national specialists. It involved multiple disciplines including urban and regional planning; economy; climate and environment; infrastructure; GIS; as well as sectoral expertise in industry, tourism, agriculture and irrigation.

THE CONTEXT OF PLANNING

The devolution process in Nepal

More than a decade into its Comprehensive Peace Agreement (2006)[1], Nepal has entered a crucial historic phase in which the provisions of the 2015 Federal Constitution are being rolled-out. The Constitution established a three-tier federal state, including seven provinces and 753 municipalities, both urban and rural. A devolution process is on-going, underpinned by a slow yet steady urbanization process (WB, 2013). The Constitution assigns to Provincial Governments – in place since the 2017 elections – the role of developing "agriculture and livestock, factories, industries, businesses, transportation" as well as aspects related to education (provincial universities and high schools) and business. All vital aspects for territorial competitiveness and, ultimately, development.

Devolution may be an opportunity for the country whereby stronger sub-national governance can play a positive role in economic development. Such subnational participation ensures more intimate knowledge of the local economic fabric and is at a critical scale for developing value-chains, absorbing economic shocks, and linking-up with national value-chains, policies and programming. The aspirations for this process include more balanced national growth and multi-polar urbanization of primary, secondary and tertiary cities; and, ultimately, sustainable economic growth.

There is no definite consensus on the effectiveness of devolution of economic development. In some countries, however, there is emerging evidence – for instance in Vietnam – that devolution may well stimulate incubate ideas, promote innovation, attract investments, promote domestic economic capacities and competitiveness and ultimately promote growth that harnesses ideas, talents, assets and resources at regional and municipal scales (Asia Foundation, 2018).

The roadmap to secure this opportunity is also dotted with pitfalls. The statutory roles and responsibilities entrusted by the Constitution to the Provinces require them to develop their own development plans. However, the Provinces must do this without a workable blueprint, limited technical capacities, and in some cases with external support. Also, the 'principle of subsidiarity' that underpins the three-tiers of governance in Nepal demand some coherence across local, provincial and federal planning. Achieving this coherence will entail considerable trial and error.

Challenges and opportunities for development in Nepal

With a population of nearly 30 million people, Nepal is a landlocked and predominantly mountainous country, ranking low on the Human Development Index. Its economy is increasingly service based, but heavily dependent on external factors like imports and remittances, and competitiveness is influenced by neighboring regional powers India and China. Internally, development is influenced by challenging geo-morphological and climatic conditions; the observed effects of climate change; and fast-degrading environment.

Despite these challenges, Nepal has achieved constant economic growth for many years, albeit at a slower pace than other countries in the region. It has also made considerable progress in reducing poverty since the 1980s with the incidence of poverty falling from 46% in 2001 to 15% in 2011 (WB, 2018). Small and Medium Enterprises (SMEs) are emerging and expanding in the provinces; urbanization processes are also yielding socio-economic dividends; and education indicators are improving.

However, progress remains concentrated spatially, particularly in the Kathmandu Valley and the Tarai Plains to the south, which are traditionally the agricultural heartland of the country and more recently the industrial and trade hubs with open borders to India. In contrast, the mountainous northern areas remain less developed and accessible.

Overarching principles of the plans

Our work involved supporting two provinces, Karnali Province and Province Two to develop a practical development plan, complete with a list of actions prioritized on the basis of robust evidence. These actions must be locally driven and grounded in the economic, environmental, social and infrastructure reality; and implemented during several planning cycles.

The two provinces could not be more different from each other. Karnali is the largest province by land area with the smallest population, whereas

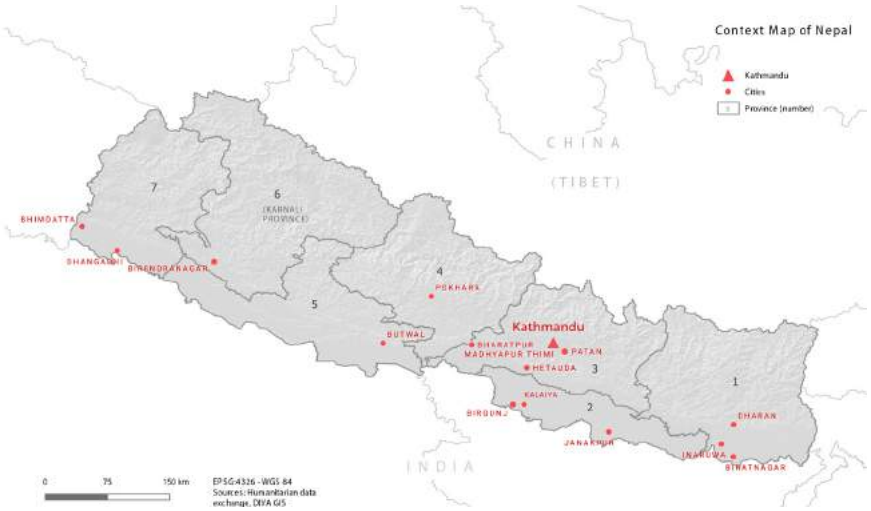

Figure 1: Context Map of Nepal *

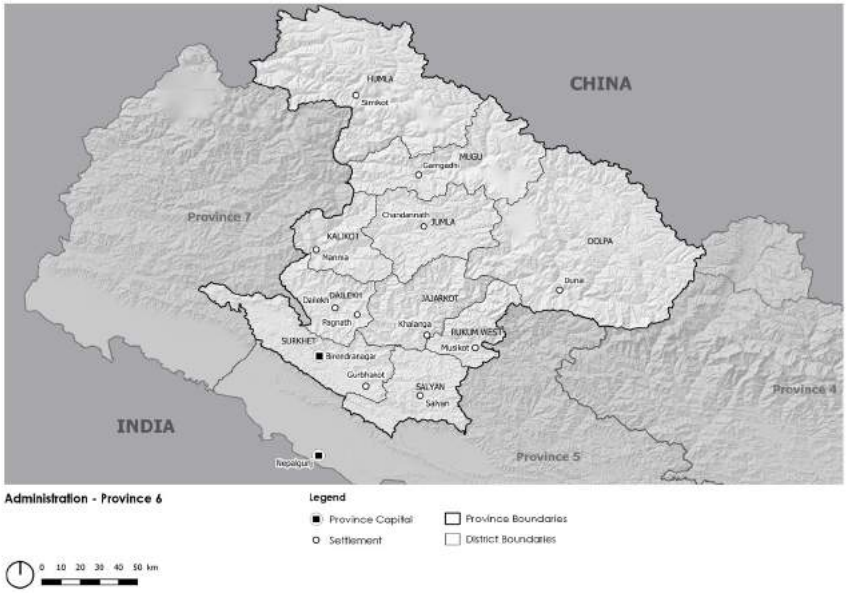

Figure 2: Administrative map of Karnali Province *

Province Two is the smallest by land area with the highest population density.

To the northwest, the Karnali Province is named after the second major river of the country. It is characterized by three contiguous ecological belts, extending east to west, over very challenging terrain. The Province's landmass encompasses high mountain ranges of the higher Himalayas (up to 7,500 meters); lower Himalayas or 'hills', at about 3500 meters; and valleys on the shoulder of the Siwalik hills, which separate the Province from the Tarai belt to the south. The Province borders Tibet to the north, and other Nepali provinces to east and west. Karnali Province is a 'political region', in that its administrative borders were designed to incorporate different sub-regions with limited economic density and interlinkages, with the goal of inducing development in more remote areas.

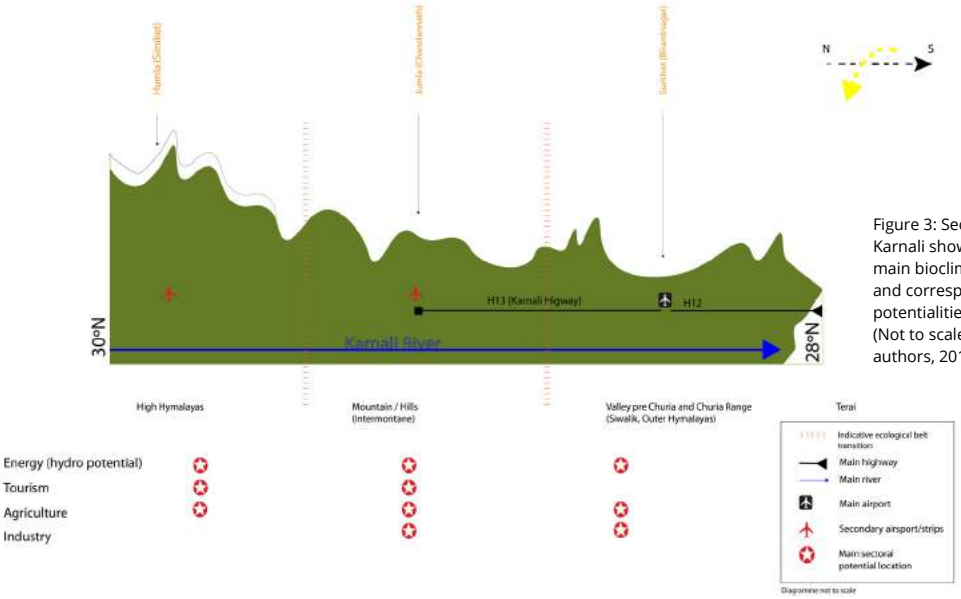

Figure 3: Section of Karnali showing the main bioclimatic areas and corresponding potentialities.
(Not to scale image by authors, 2019)

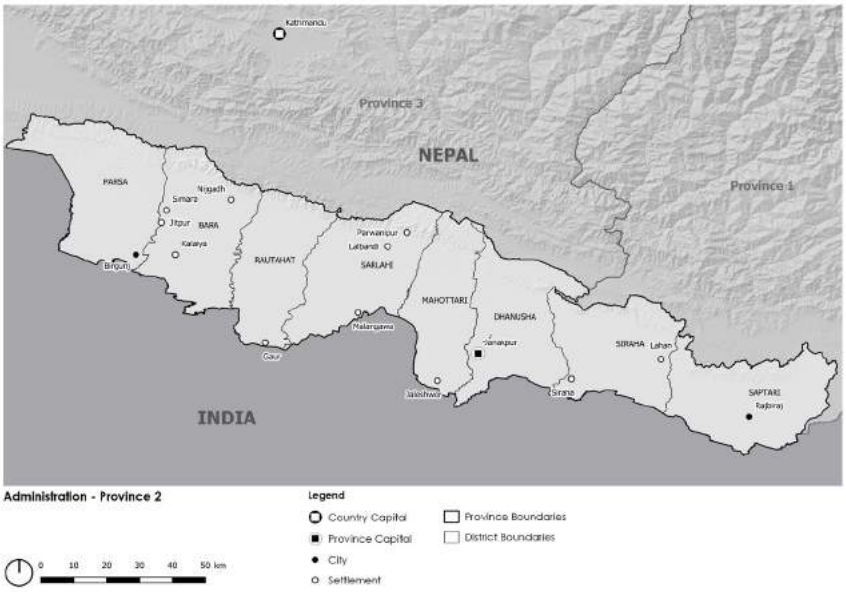

Figure 4: Province Two administrative map. *

To the southeast of the country, Province Two encompasses a predominantly flat area, drained by several rivers. This is a rather natural region, with homogenous and interconnected economic clusters, along transport axes in all directions. This fertile land in the Tarai belt supports agriculture and is well-connected over unchallenging terrain. Its largest city, Birgunj, is located on the north-south axis that connects Kathmandu with India. The Province shares an open border to the south with India and is otherwise bordered by other provinces of Nepal.

While different in many regards, the two provinces are equally exposed to a range of natural hazards, are highly vulnerable to the projected effects of climate change and are experiencing fast trends of environmental degradation.

As always, the plans are an end-product of negotiated tensions among economic priorities, social needs and environmental constraints. In this case, the extreme fragility of the environment coupled with the observed and projected effects of climate change compounded these tensions.

Not all could be successfully negotiated five reference points early in the process helped us keep that balance upright. Firstly, whereas the overall purpose of the plans is to generate economic growth for the province, this must not be at the expense of social inclusiveness, environmental health, and low-carbon future scenarios. Secondly, the plans should bolster resilience in the province by ensuring that socio-economic and infrastructural development will be able to withstand, respond and adapt to exogenous and endogenous shocks and stressors now and in the future. Failing to do that would negate economic benefits overtime and affect the most vulnerable people in the province. Thirdly, the process and plans are inclusive and participatory: projects identified under this process should benefit all actors in society. Fourthly, they must be evidence-based to ensure that ambitions are high, yet grounded in what the territory can deliver now, and in the future. And, finally, the plans should be result-based so they are clear on what, when and how priorities should be implemented.

These principles helped to steer the planning process. From the concept stage down to the detailed list of projects, actions that may contradict or hamper any of the five principles required a very strong business case to be considered a strategic objective and be short-listed for implementation. In practice, very few contradictory ideas withstood that proofing process.

PLANNING PROCESS

A four-stage methodology

Both plans required that ambitions (sometimes politically motivated) were supported by convincing facts about the actual potential for agriculture & irrigation; tourism and industry in the provinces. To help in that we adopted a four-stage approach consisting of baselining; participatory concept-design; strategic objectives-setting; and prioritization of projects for the final plans. The idea was to funnel proposals, concepts and ambitions through the baseline and participatory planning process in order to progressively substitute unrealistic or sector-mandated objectives with legitimately ambitious yet evidence-backed goals, supported by a suite of feasible short, mid and long-term projects.

Our priority for these plans was to 'future-proof' development concepts and ideas, to enable provincial authorities to short-list sectoral projects based on their feasibility against projected changes in climate and within their fragile environmental settings.

To 'future-proof' plans we first analyzed present conditions across environmental, socio-economic, spatial and infrastructure systems. This (more traditional) part of the work entailed identifying potentials and constraints of the regions; their comparative advantages and opportunities; and assess their competitiveness as of 2019. We then modelled a future induced by changes in climate and assessed how this may affect the provinces spatial and economic systems.

We used quantitative data to set-up a multi-criteria index and assess current and projected vulnerabilities and risks to natural hazards, and climate change impacts across socio-economic, infrastructure and services, and environmental indicators, up to 2050. Data included social and service indicators, such as education levels and employment to ensure that findings fully captured the current socio-economic context.

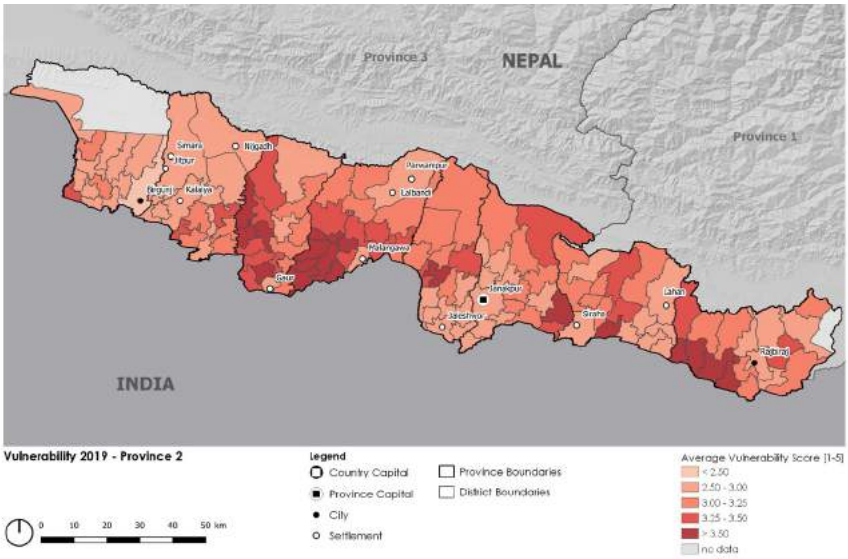

Figure 5: Vulnerability to multi-hazards in districts of Province Two in 2019; based on multi-criteria socio-economic, infrastructure and environmental indicators*

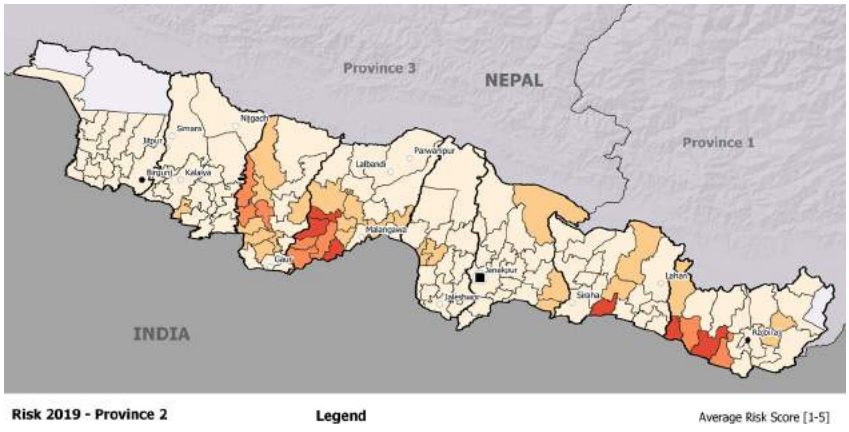

Figure 6: Risk to multi-hazards in districts of Province Two in 2019; based on multi-criteria socio-economic, infrastructure and environmental indicators*

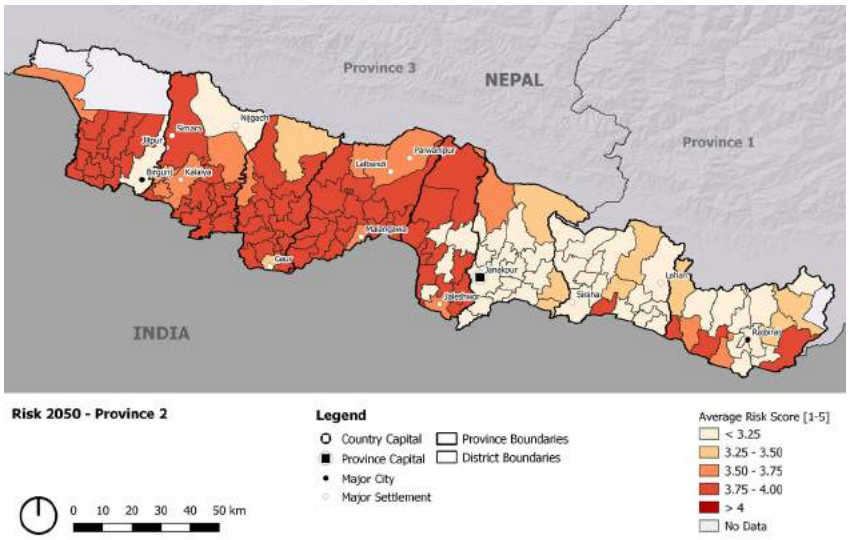

Figure 7: Risk to multi-hazards and climate change projections in districts of Province Two in 2050; based on multi-criteria socio-economic, infrastructure and environmental indicators. Increased natural hazards and the impact of changes in climate are likely to increase risks for people, assets, and economic activities across the Province*

To complement these data, we also administered questionnaires at district level to create an inventory of services and functions available in all settlements. We then built this information into a *Matrix of Functions (*MoF) (Boerboom et al., 2016; Spaliviero et al., 2019) and rendered it spatially. This matrix shows territorial concentrations of socio-economic or administrative functions[2] as aggregated clusters, which in turn reveal the spatial structure of the provinces, nodal linkages, and development gaps. By superposing population density, for instance, we were able to identify large underserviced areas of Karnali, which will require job-intense and service-generating sectoral investments in industry and agriculture. We then projected climate change on several inventoried functions and services to estimate a 'future' spatial structure, by 2050.

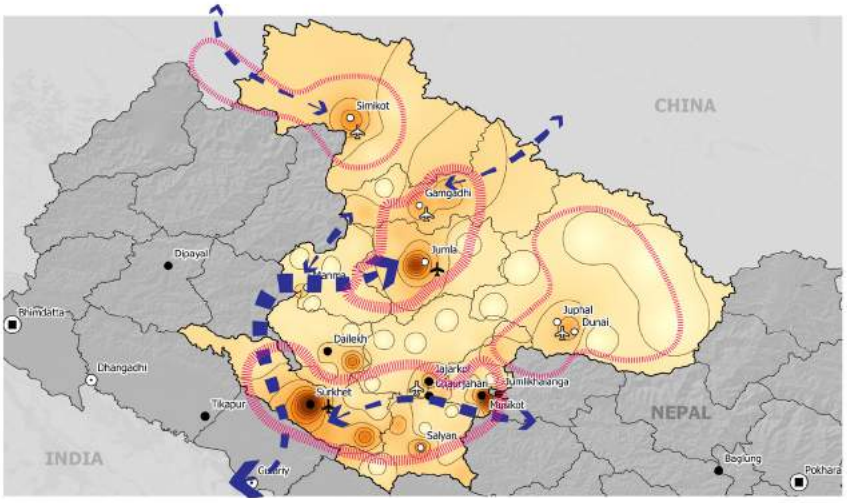

Figure 8: Spatial structure of Karnali in 2019. Clusters and main emerging corridors emerge, from concentration of services and functions (Map by authors, 2019)

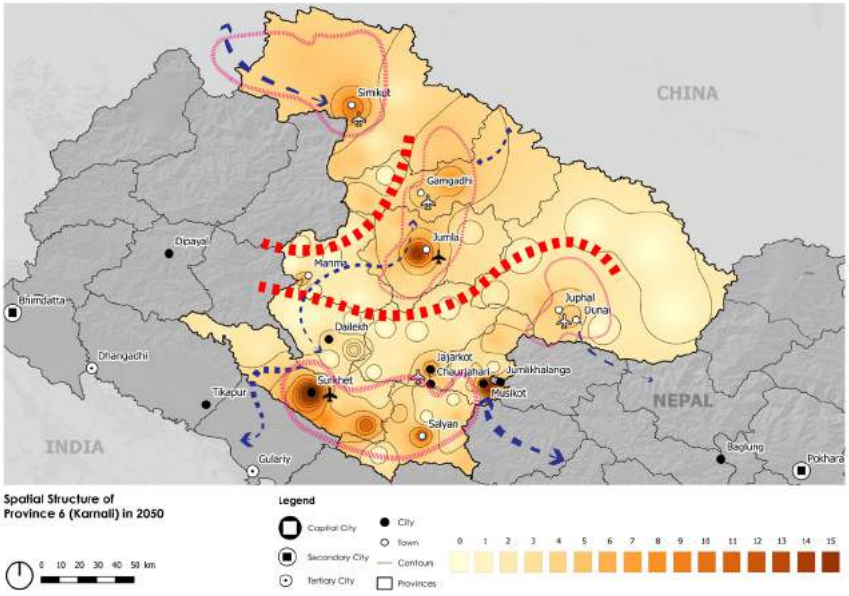

Figure 9: Possible changes in the spatial structure of Karnali in 2050, based on climate change projections and deterioration of ecosystem services. The red lines show an expected fragmentation in isolated clusters, with negative effects on supply-chain and development failing to invest in adaptive investments such as smart agriculture and resilient infrastructure (Map by authors own, 2019)

We used these spatial data to assess whether Karnali and Province Two, given the projected changes in climate, will be able to sustain the same economic functions, and what types of interventions would be best suited to generate economic outputs in the context of climate change. For instance, the expected increased frequency of torrential rains inducing landslides may have negative consequences for the apple value-chains[3] around Jumla in Karnali. Similarly, the expected increased evaporation of water sources in Province Two may affect long-term prospects for agriculture. In the former case, shorter circuit value-chains, and resilience measures for building trunk infrastructure assumed an economically and social strategic importance; as did efficient irrigation schemes in the latter.

The combined analysis of quantitative data, the MoF outputs, and the review of secondary data, lent the 2019 baseline a credible standing, despite shortage of economic data. The 'foresight' work for 2050, lent the plan strategic breath over the mid to long-term.

Planning with people

We worked hand in hand with public and private sector stakeholders to map the existing potential and project ideas in the territory; identify weaknesses; and to devise whole sectoral development packages. For instance, tourism packages for different target-audiences in Karnali included 'Religious and cultural' areas near temples of the north and center to target pilgrims from India and Tibet and 'Adventure & Sacred Landscape' areas along the Great Himalaya Trek in the north and the lakes to target international tourists and so on. We sketched these potential maps and concept-maps with workshop participants and then catalogued all ideas. In some cases, these initial rough ideas were carried through the entire process and made it into implementable project packages.

Once complete, we shared our baseline findings along with a long list of project ideas captured during workshops and bilateral consultations, but this time engaging higher level authorities. At this stage we were also able to fine-tune strategic and specific objectives for each sector.

The plans started to take a firmer shape. The current baseline analysis was received well, and its robustness was appreciated at this stage. Potential impact of disaster risks were also understood, and mitigation measures discussed. While agreeing on the already visible effects of climate change on the hazard profile of their provinces, policymakers were less prepared to plan for the long-term implications of climate change on the ecosystem and the economic functions of the Provinces, perhaps unsurprisingly. Ultimately, the strategic and specific objectives were adopted in both provinces as part of the process, and a project prioritization process started.

From concepts to development packages and project proposals

The concepts designed at the beginning of the process were then refined and transformed into 'development packages' that contributed to achieving the strategic objectives and specific objectives for each sector, and across sectors.

For each development package a series of projects were prioritized to include technical feasibility studies; skill-development initiatives; capital investment projects; and policy-development. Projects were then assigned cost categories, to be submitted for finance to the central government or other finance sources.

Climate change, environment, and social sustainability considerations were firmly engrained in the strategic principles and the set of prioritization criteria adopted to short-list sectoral projects. As mentioned, this forced stakeholders

Figure 10: Sketching during the initial participatory design studios, in Karnali (Image by authors, 2019)

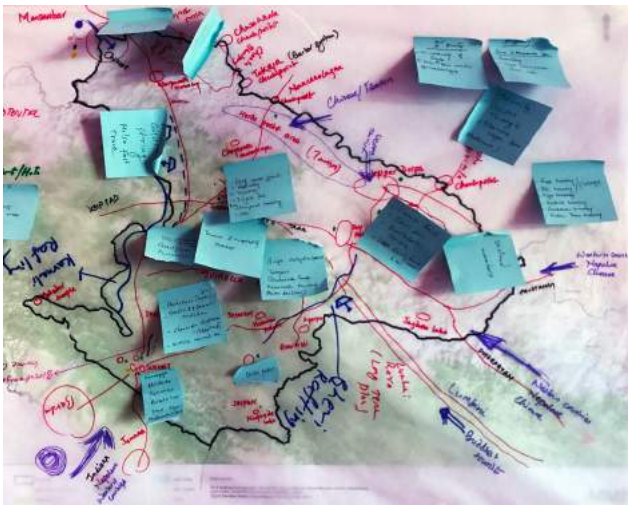

Figure 11: Sketch for tourism potential and challenges, prepared by stakeholders in design studios in Karnali (Image by authors, 2019)

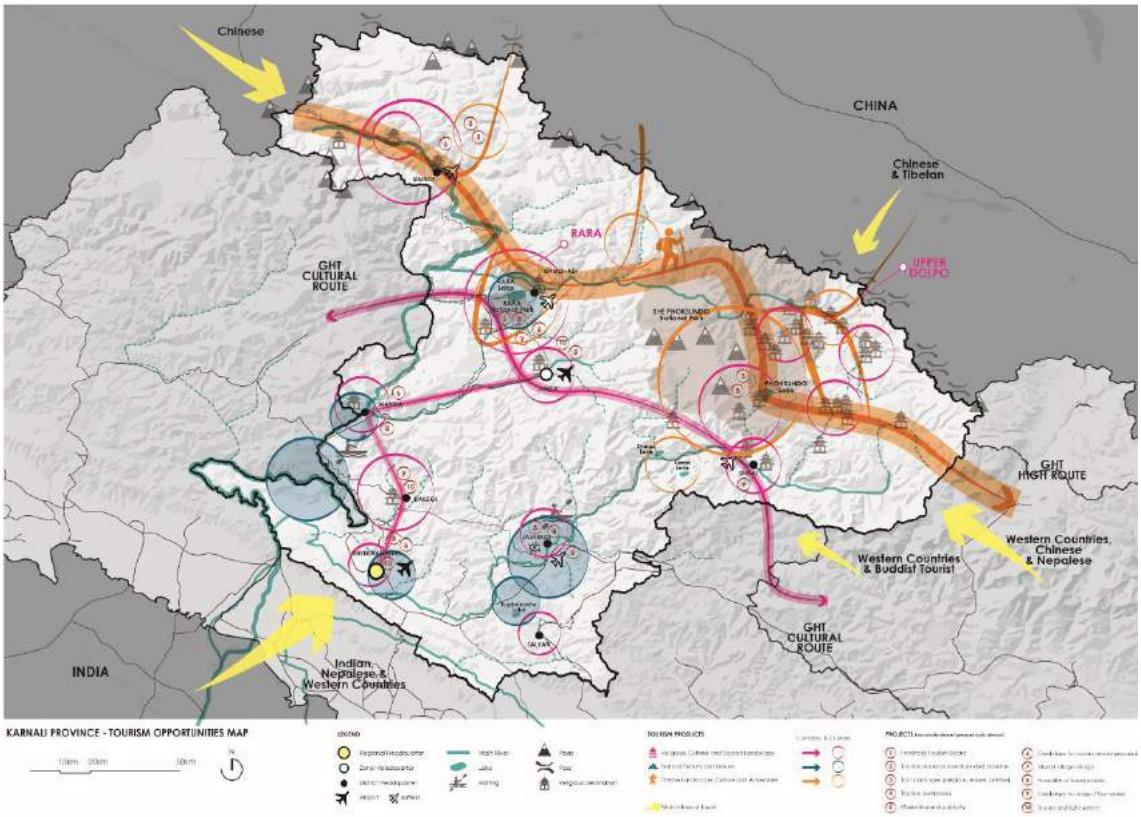

Figure 12: From initial ideas sketched in design studios, to fully advanced development package ideas. The Province hopes to take advantage of its position along the Great Himalaya Trek, among others. Environmental challenges and climate change may have an impact in the long-term on the viability of these projects, without sustainable and adaptive development (Map by authors, 2019)

Figure 13: Project prioritization workshop in Province 2 (Image by authors, 2019)

to think in terms of mutual benefits across the sectors as well as coherence with the principles agreed for this work. Most projects included in the short-list are coherent, and few are contradictory. When they are, their 'ranking' is also low: policymakers may still decide they must be implemented, but hopefully with consideration of the potential negative effects for the overall development strategy.

To ensure the central position of climate change, environment and social inclusiveness in the overall prioritization process, criteria also included expected co-benefits across sectors. In other words, the value of a given project to complement other sectoral or cross-sectoral initiatives; its financial and technical feasibility were portrayed together with its social, environmental and resilience value. A final score was assigned to gauge projects on how well they were aligned to the guiding principles of the planning process.

Constraints

In our view, the sectors with most potential to generate economic development, based on analysis of the context, should emerge from the planning process showing comparative advantage and competitiveness of the region. However, in our study sectors were an input, pre-determined by the other policy processes in the country. As such, the question was less "what sectors are more likely to generate economic development" as much as "how can agriculture & irrigation; tourism; and industry be productive in the provinces". Infrastructure and governance functioned as enabling factors across the three sectors. Our work involved a considerable effort to ensure a 'cross-sectoral' approach, based on evidence. Inevitably, however, a certain fragmentation transpired in the final outputs.

Also, planning at the provincial level is a recent exercise in Nepal, under the new Constitution. The lack of a blueprint enabled a distinctly creative process, but it also resulted in unclear engagement patterns with the authorities. From a menu of methodology options, individual approaches and tools were utilized to navigate the step-by-step process from the baseline to objective settings,

Figure 14: The Ram Janaki Temple in the City of Janakpur, Province Two. Developing cultural and religious tourism is a priority in the Province (Image by authors, 2019)

Figure 15: Karnali dramatic landscape, yet challenging for development. Observed and projected effects of climate change include an increase in torrential rains, and rainfall-triggered landslides, which may cut roads, affect supply-chains and further isolate communities (Image by authors, 2019)

and prioritization. Some tools (like the MoF) proved unexpectedly successful while others were unfortunately omitted. In particular, time constraints, and challenges with participatory engagement forced us to forego a *Spatial Multi-Criteria Evaluation* (SMCE), which we thought important for reality-checking development objectives in the Province.

Finally, for a development plan focusing on economic sectors, we were hard-pressed to find detailed economic data (especially the industrial classification of economic activity at the provincial scale) to measure competitiveness quantitatively, at least within the time and financial constraints of our work. But the planning also showed that a supposedly data-scarce environment may yield surprisingly vast amounts of data. In Nepal, data may be guarded in ministries, hard-copy publications, or in files from previous technical assistance projects.

THE WAY FORWARD.

The outputs

The final results of the planning effort consisted of a robust yet succinct analysis of the potential for development currently and in the future; strategic recommendations, goals and specific objectives for the province as a whole, and for the three target sectors, along with a detailed short-list of projects for implementation in the short, mid and long-term.

For instance, in Province Two, the final planning report adopted an overall development strategy led by innovation in industry and consolidated agricultural productivity, with climate adaptive agriculture. The planning report insists on the high potential for economic development in the Province, but also the need for more equitable distribution in response to the current social

indicators. Redistributing the economic returns more equitably through deeper local supply chains that increase local economic multipliers (particularly in tradable items like fruit, value addition such as manufacturing, or processing activities like cement) was therefore the core of the strategy.

A series of coherent development packages are then adopted that satisfy the strategic sectoral goals, with appended detailed short-lists of projects. For instance, in Province Two, Development Package 2 consisted of the "Improvement of enabling and market infrastructure to enhance the quality of agricultural harvests and processing". Relevant projects include: "Procurement and operation of mobile soil laboratories for scientific soil management /improvement; Ground water development in the area of surface irrigation to supplement water in dry period (October to June) and / or new area of irrigable land to ensure assured irrigation in 91,000 ha of agricultural land; Establish provincial level skill development and training center at Birgunj, Janakpurdham and Rajbiraj".

The planning process contributes to the outcomes EPI and the provincial governments want to deliver, within a forward-looking perspective of a changing climate and ever more fragile environment.

The four-stages approach we adopted was sufficiently flexible to allow for multiple changes of direction, which may be expected in planning processes and especially where no prior blueprint exists. The National Planning Commission (NPC) of Nepal acknowledged this and has asked for the methodology to inform planning processes in other provinces.

Learning lessons for going forward

Population forecasting, sectoral needs projections, economic competitiveness modelling and other tools of the craft remain an integral part of regional planning practices. In our views, however, the climate and environmental emergency demand that all planning practices evolve to provide better a account of different futures, especially at regional scale.

25 million kilometers of roads are expected to be built in the next two decades, mostly in pristine areas of the Global South (WWF, 2019). In the same timeframe, most land that remains to be urbanized will be developed especially in Africa and South-East Asia. In this time-window, we will also experience further climate change effects. There is ample justification to turn our attention to how regional planning can best integrate climate change and sustainability into its workflow. There is no shortage of climate change assessment techniques that can be used to inform regional planning methods, and be incorporated in existing methods, such as such as the MoF developed and applied by UN-Habitat in several countries.

We therefore propose to make climate change, environmental and social analysis a pivot of the regional planning workflow. As planning consultants, we may have little capacity to foresee how this forward-looking information, underpinned by sustainability and resilience principles, will actually be used by authorities to balance infrastructure and economic progress with low-carbon, sustainable development. But this work in Nepal is our honest contribution towards this effort, and we have reasons to believe it will be further developed and replicated in the country, and elsewhere.

* Map by authors, 2019. Disclaimer: this map is for illustration and planning purposes only and uses datasets available in the public domain. The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of the authors

Endnotes

1 See the following for more information about this agreement. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=2ahUKEwjxzYGt3aTpAhW3hXIEHVHNCbQQFjABegQIAxAB&url=https%3A%2F%2Fen.wikipedia.org%2Fwiki%2FComprehensive_Peace_Accord&usg=AOvVaw2aVyNhRa4WCCxAw7Lt2MpN

2 This method was developed and perfected by the United Nations Human Settlements Programme (UN-Habitat) in several countries, and is discussed by Spaliviero et al. (2019) and Boerboom et al. (2016

3 See : https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&ved=2ahUKEwj9i-yj6KTpAhW2oHIEHbjiCucQFjADegQIAxAB&url=https%3A%2F%2Fresearch-methodology.net%2Fapple-value-chain-analysis%2F&usg=AOvVaw1x-ASUldHy2on8CAN0NKGG

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Figure 16 Pigments for religious ceremonies in the City of Janakpur, Province 2. Developing cultural and religious tourism is a priority in the Province (Image by authors, 2019)

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Han Admiraal, trained as a Civil Engineer (University of Applied Science, Rotterdam), is the co-chair of International Tunnelling and Underground Space Association's Committee on Underground Space (ITACUS), and a past-member of the Urban Planning Advisory Group of United Nations Office for Disaster Risk Reduction (UNDRR), advising the Special Representative. As President of the Dutch-Flemish Pipeline Industry Guild, he promotes underground freight transport as a sustainable and economically efficient mode.

Over the course of his career, Han worked for the National Department of Public Works and Water Management, acting amongst other positions as Project Manager for the first machine excavated (TBM driven) tunnel in soft soil in the Netherlands. Later, as Executive Director of the COB, the Netherlands Centre for Underground Construction, Han implemented visionary concepts on underground construction, and was a part-time professor of Underground Space at Zeeland University of Applied Science. Since 2008, he is the Owner and Managing Director of Enprodes Management Consultancy in Delft, consulting in the fields of underground space and road tunnel safety.

Han is passionate about urban planning, and an interdisciplinary dialogue between various stakeholders and professional disciplines dealing with urban and underground development. Having published numerous articles on this topic, he published his first book, written together with Antonia Cornaro, in 2018.

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Jens is an associate partner at BUUR - Bureau for Urbanism, specializing in sustainable urban development programs and policies. In the recent years, he has focused on international urban policy and innovative governance, working with UN-Habitat and UNICEF on child-friendly cities initiatives, road traffic injuries prevention programs, urban and planetary health, including training and technical assistance in regional and country offices.

He holds a MSc in Civil Engineering and Architecture from the University of Leuven (Belgium) and obtained his MA Urban Planning at Universitat Politecnica de Catalunya in Barcelona (Spain). He is a member of the Board of the Flemish Spatial Planning Organization (VRP), and the International Society of City and Regional Planners (ISOCARP) where he leads a Community of Practice on Urban Health.

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He delivered lectures and presentations in over 25 countries and has been invited to present his research work at international institutions such as University of Oregon, Illinois Institute of Technology, Drury University, Cambridge University, University of Seoul, Malaysia International University, University of Belgrade, and American Universities in Beirut, Sharjah, Kuwait and Cairo. Alraouf is the recipient of number of awards including the innovation award in environmental and sustainable planning from Ministry of scientific research in Egypt 2000, Modern Science and Arts University (MSA) Teaching Excellence Award 2004, Best Research Paper in Sharjah International Conference for Urban Planning 2008 and Research Publication Achievement Award from University of Bahrain 2009. Alraouf was selected as member of 2012 Excel campaign at Qatar University and the distinguished speaker of the Arab Future Cities Summit 2016. His book "Knowledge-based Urban Development in the Middle East was awarded by ISOCARP in 2018. Alraouf's research paper was also awarded best research paper by a scholar at the UC- Berkeley biannual conference in 2018. Alraouf is currently acts as Head of capacity building, training, research and development unit at Ministry of Municipality and Environment (MME) in Qatar. He is also a visiting professor at HBK University in Qatar-Education City, and the leader of Green Urbanism and Planning Group at Qatar Green Building Council (QGBC).

Atmadja, Felicia

Felicia Atmadja is an architect, interior designer and urban designer based out of Jakarta, Indonesia. She is currently working as an architect and interior designer in Jakarta while also actively working on urban design research. She recently graduated from the University of Auckland as a Master of Urban Design in January 2020. Before, she studied architecture at the University of Brawijaya, Indonesia. Felicia has participated in the 55th ISOCARP World Planning Congress, presenting a paper titled "Shaping Compact Cities for Liveability, Affordability and Sustainability (L-A-S). A Comparative Assessment of TODs in Jakarta and Auckland". She also took part in the 2019 Young Planning Professional Workshop. She was a New Zealand ASEAN Scholarship Awardee and the 1st winner of eco-friendly house design competition.

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Dushko Bogunovich is an architect, urban designer, town planner, academic and advocate, with residence in Auckland, New Zealand. He is an independent researcher and adjunct professor at the School of Architecture and Planning at The University of Auckland. Recently, he was the inaugural Dean of the Faculty of the Built Environment of the Ba Isago University in Botswana.

Dushko studied at the universities of Sarajevo; Belgrade; Cyprus; Pennsylvania; and California/Berkeley. He has authored/co-authored over 100 research papers, reports and design or planning projects. He is a life member of the International Society of City and Regional Planners (ISOCARP), member of its Executive Committee, and chair of its Scientific Committee.

Dushko is a member of the New Zealand Institute of Architects (NZIA), and of the Urban Design Forum (UDF) of NZ. He was twice a Fulbright scholar, has won several urban design competitions, and multiple research travel grants and fellowships. He has worked with UNDP, UNEP and UN-Habitat; and was visiting scholar at universities of Oxford, Bologna, Genoa and Milan.

Brewster, Roger J.

Roger Brewster has a multi-faceted career in land use and environmental planning spanning 45 years and is a corporate member of the Planning Institute of Australia. He graduated with a Bachelor of Science from RAAF Academy to become a pilot. While flying, he completed a Master of Town Planning Degree at Adelaide University and subsequently was appointed to establish a unit undertaking environmental assessment for the Department of Defence.

After a period in the Commonwealth Department of Science and Environment, Roger established an independent environmental planning consultancy at the Gold Coast in 1981, covering urban development in over 850 projects. He established the Gold Coast branch of the Planning Institute of Australia as the inaugural President.

From 2009 to 2017, Roger was appointed as a Principal Planner in the Queensland Government planning department, undertaking development of climate change and planning reform policies. After the disastrous 2011 floods, he contributed project and flood risk management expertise in the Brisbane River Catchment Flood Study. Roger completed a PhD at Bond University in the field of sustainable planning in 2016, researching adaptation strategies for sustainable urban residential development in an oil-constrained future. He now lectures at Bond on urban planning and sustainable development.

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Katharine Burgess is Vice President of the Urban Land Institute's Urban Resilience program and co-author of *Scorched: Extreme Heat and Real Estate*. Through research, advisory services, convenings and outreach, ULI's Urban Resilience program works to leverage ULI's global network to help communities prepare for increased climate risk and make wise investments in infrastructure, development and building design.

An urban planner with 15 years' experience, Katharine has practiced urban planning in the United States, the United Kingdom, and Germany, with global project work across the United States, Europe, and Asia. She began her career managing post-Katrina hurricane recovery charrettes commissioned by the states of Louisiana and Mississippi and the city of New Orleans. She has since worked on a range of large-scale, mixed-use master planning initiatives designed to encourage pedestrian activity and integrate green infrastructure, including campus plans, downtown revitalization plans, urban extensions and a new town for 10,000 people in Scotland. Katharine's research work has included landscape performance research for the Landscape Architecture Foundation, as well as international urban development research for the Robert Bosch Foundation Fellowship program, during which she completed a work placement at the City of Berlin's Department for Urban Development. She received a BA from Williams College and an MSc in Regional and Urban Planning from the London School of Economics.

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Pasquale is the lead of Climate & Disaster Resilience focus area at Arup International Development. He is an urban and regional development professional specialised in climate change, resilience and sustainability. He has more than 17 years' experience in designing and managing programmes at national, regional and city level in Asia, Africa, Latin America and Europe. In his current work, Pasquale leads planning, technical assistance, advisory, policy and research assignments in countries of Asia (e.g. Nepal, Myanmar), Africa (e.g. Ghana, Malawi), and Latina America (e.g. Argentina, Dominican Republic) with international development banks such as the WB, ADB; the UN, including UNDP, UNHCR and Unicef, as well as private and public funds, including the GCF, national and city-governments. Prior to joining Arup, he served for 15 years with the United Nations, including as Chief Technical Advisor on climate change and disaster resilience in several countries of Asia, Africa and Central America. In this role, he supported the development of national climate change policies; city and regional level adaptation plans; vulnerability and risk assessments; risk-responsive land-use and strategic masterplans; as well as low-carbon and climate resilient green and hard infrastructure. He holds MSc and PG.Dips in Urban & Regional Planning and MAs in Development.

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Giulia holds a MSc degree in Management of Built Environment from Politecnico di Milano and a MSc in Facilities Management from University of Brighton. In 2013, she pursued a PhD scholarship at the University of Greenwich in Facilities Management with specialization in sustainability and Building Information Modelling (BIM) in existing buildings. She worked for several years in London as a consultant for private and public clients in the UK and Europe, providing strategic review of the estates and facilities functions. Giulia is involved in the EU H2020 +CityxChange Project as Innovation Manager.

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Gary Brett Clavio currently serves as the Senior Transportation Planner for Santa Fe County. In addition, he practices urban planning and architecture as a small business. He has been a member of ISOCARP since 2003. Other activities and interests include art, music, philosophy, cuisine, and travel.

Cornaro, Antonia

Antonia Cornaro, MA Urban Planning (1996), studied at the New York University and then gained valuable experience working for the City of New York's Planning Department (DCP) in their Transportation Division. She has 20 years of working experience as an urban and transport planner from the public and private sector from New York City, London, Vienna and Zurich, having worked for NYC Department of City Planning (1995-1997), Parsons Brinckerhoff (PB now WSP from 1997-2001), the Austrian Institute of Regional Planning (ÖIR, from 2001-2006), and the Zurich based multi-disciplinary engineering consulting firm EBP (2006-2010).

In her current work as Business Development Manager for Amberg Engineering, an internationally active Swiss firm specializing in underground infrastructure design and management, she focuses on Urban Underground Space with the aim to increase mobility, livability and resilience of urban areas (since 2010 until today). It is also central to her work as Co-Chair of ITACUS (the International Tunnel and Underground Space Association's Committee on Underground Space, http://ita-aites.org/.). Antonia is passionate about cities, global and sustainable development, and has presented and published extensively on this subject, often jointly with Han Admiraal. Together with Han she wrote the book "Underground spaces unveiled: planning and creating the cities of the future" (more info: www.thinkdeep.net) which was published in 2018. In 2020 Antonia started lecturing a course on Underground Space Planning at the ETH Zürich.

De Paep, Miechel

Miechel De Paep is an urban designer and planner with a Master's Degree in Architectural Engineering (KU Leuven) and European Urban Studies (Bauhaus University Weimar). In 2008, Miechel joined the team of BUUR | bureau for urbanism where he works as project leader, designer and urban planner. He leads most of the research projects of BUUR, but also coordinates different strategic planning projects on urban or regional scale. His main focus is urban-scale sustainability in all its aspects: mobility, climate, energy, ecology, social justice. He developed the Sustainability Compass, an instrument BUUR uses to evaluate its own projects, but also several other assessment methods to help local and regional authorities to become more sustainable and climate friendly. His knowledge on these themes makes him a welcome expert in a wide range of design projects.

Miechel is active as an editor of different project reports, articles and books. He is the coordinator of BUUR's research and development cluster, and responsible for the content of the BUUR website and social media channels. In his free time Miechel helped coordinate the temporary refurbishment of the Damiaan Square in Leuven for the local grassroots organization Straten Vol Leuven. With his wife and daughter, and 27 other families, he lives in a sustainable cohousing project in the center of Leuven, a project he helped initiate.

Dubbeling, Martin

Martin Dubbeling is an urban planning and design practitioner based out of the Netherlands. He is the founder and principal of Connecting Cities (Visie op Ruimte), an office for research, consultancy, design and communication in sustainable urban and regional planning. Martin Dubbeling is also the President of ISOCARP (2018-2021), the International Society of City and Regional Planners. As Vice President of ISOCARP (2011-2017) he organised successful Urban Planning Advisory Team (UPAT) workshops in Singapore, Russia, Palestine, China, South Africa and Norway. In 2018, the School of Architecture and Urban Design of the Wuhan University appointed him as visiting professor. Since 2018, Martin Dubbeling is senior urban planner and urban designer of Delfzijl in the Netherlands, focussing on rebuilding, restructuring and transforming Delfzijl into a sustainable and resilient city.

Foster, Elizabeth

Elizabeth Foster is a Manager with the Urban Resilience program and co-author of *Scorched: Extreme Heat and Real Estate*. She conducts research and collaborates with ULI staff and members to provide knowledge and share innovative practices that help communities prepare for and adapt to climate risks.

Before coming to ULI, Elizabeth focused on disaster management and climate change adaptation in the private sector with a multinational insurance company and then internationally with U.S. Peace Corps Response. Elizabeth began her career developing the sustainability plan for her alma mater and expanding environmental education at an urban greening/youth empowerment nonprofit in St. Paul, MN. Passionate about equitable sustainable development, Elizabeth has also helped administer a joint UNEP/ELI class on environmental security and sustaining peace.

Elizabeth received a B.A. in Environmental Studies from Macalester College (St. Paul, MN) and a Certificate in Emergency Management from Drexel University (Philadelphia, PA).

Gall, Tjark

Tjark is project manager and work package lead for communication and dissemination for the EU H2020 +CityxChange project, which aims at co-creating positive energy districts through integrated planning and design and a common energy market in secondary cities in the EU, and as an individual urban research consultant. He obtained an MSc Urban Management and Development Studies from the Institute for Housing and Development Studies, Erasmus University Rotterdam (NL), and MSc Architecture from the Technical University Brunswick (GER). Before joining ISOCARP Institute, he worked on numerous research and design projects. These were, among others, as a research assistant for sustainable rural-urban development at the Institute for Sustainable Urbanism, Technical University Brunswick, Germany; the development of indicator-based sustainability assessment frameworks; and the analysis of the climate risk and urban form nexus in Kampala, Uganda. Furthermore, he participated in and co-organized workshops in Indonesia, Ireland, Austria, Brazil, Germany, South Africa, Malawi, Norway, and Curaçao.

Gill, Darren

Darren is a Senior Consultant in Arup's International Development team. He has 14 years' experience working with inter-disciplinary teams in the private and non-profit sectors across a range of project types, scales and stages including economic development, urban and regional planning, urban resilience, urban upgrading, social infrastructure (education, healthcare, housing), and post-disaster reconstruction. Previously based Rwanda, Haiti and Uganda, Darren led teams and managed $10m+ programmes across East, West and Southern Africa, and South Asia. Darren originally trained in architecture and urban planning before completing a masters at the London School of Economics in City Design and Social Science with a concentration on urban economics and governance. His research focused on municipal finance and the economic development impacts of infrastructural investment which he has subsequently applied for DFID and others in Nigeria, Zimbabwe and Nepal.

Horn, Christian

Christian Horn is a German architect, living and working in Paris, France. His architecture and urban planning office RETHINK focus on the transformation of cities, the quality of public spaces, as well as the rehabilitation of existing buildings with environmental concerns (www.rethink.fr). He teaches at different schools of architecture in France, and regularly publishes texts in international medias and on his blog (www.urbanplanet.info) about architecture and urban planning in France. Parallel to these activities, he is member of a consultative council of the city of Paris on European issues, involved in competition juries and engaged in professional associations like ISOCARP.

Iranmanesh, Nasim

Nasim Iranmanesh graduated from Azad university of Tehran in architecture and graduated from university of Tehran in urban designing. With a PhD in urban planning from Islamic Azad university, Nasim worked as a researcher in the BHRC. She also teaches architecture and urban planning in Azad University in Tehran. Nasim has worked with the municipality of Tehran as a consultant urban designer, and the organization of Tehran Beautification.

Nasim has published several articles on urban design & architecture, in professional magazines. She is a Scientific member of ISOCARP (2017- 2020), and was a Congress team member of the ISOCARP Congress 2019. She is a member of the Society of Iranian Urban Planners and the Institute for promotion of contemporary visual art.

Pomazan, Roman

Roman Pomazan is an architect and urban planner from Ukraine, Kyiv. Graduated 15 years ago from Kharkiv State Technical University of Construction and Architecture, currently he runs his research and design group Urban Sustain Architects. Roman is a Ukraine certified architect and urban planner, and an ISOCARP member since 2018. He is also the co-founder of NGO Kyiv Strategic Society.

In his professional practice, he focuses on sustainable development, eco-cities, biodiversity and green building standards. In 2019, his collaboration with Kazakhstan architecture company Frame Art on the head with Alexandr Khvan for the strategy of urban transition of Turkistan city was rewarded with ISOCARP Grand Award for Excellence.

Rycken, Katrien

For almost 7 years, Katrien Rycken has been the director of the citywide project 'Leuven 2030', previously known as 'Leuven Climate Neutral 2030'. She graduated with Master in Engineering Architecture, and studied Urban Geography in France. Rycken worked as a unit leader on integrated building projects and public-private partnerships at Sweco, until 2013 when she started as the director of 'Leuven 2030'.

Rycken facilitated the establishment of the NGO 'Leuven 2030' and helped it grow to more than 550 companies, organizations and citizens of the Leuven community that partner up with the City of Leuven to build towards a resilient, prosperous future for all. Together with her team, she leads the systemic approach of this complex transition. She inspires partners to collaborate on climate related challenges answering the main urban missions. She's in-charge of the professional development of the scientific, communicative, participatory, operational aspects of Leuven 2030, and a proud ambassador of the European Green Leaf Award. She focusses all of her energy, not on fighting the old, but on building the new.

Steinberg, Lior

Lior Steinberg is an urban planner and co-founder of Humankind, a multidisciplinary collective accelerating the transition towards urban happiness for all. He helps cities to look beyond functionality and to plan urban spaces that make people smile.

All the projects Lior participates in have one thing in common: they create people-oriented cities. Being a Jane Jacobs' enthusiast and a fan of great public spaces, he is keen on making cities better with an emphasis on local, innovative interventions and on including residents in urban planning.

Titisari, Natalia

Natalia Titisari is currently studying the Master of Disaster Management at the University of Auckland, New Zealand. She also holds a Bachelor of Engineering (Architecture) from Duta Wacana University in Indonesia. Natalia has several years of experience working in disaster response and preparedness at the NGO and community-based levels in Nepal, Papua New Guinea and Indonesia. She has also been involved in projects and research focusing on bamboo as a sustainable and renewable material in Australia and Indonesia. Natalia is interested in the intersectionality between the environment, community, disaster management and urban design.

Wyckmans, Annemie

Annemie is professor and leads NTNU Smart Sustainable Cities at the Norwegian University of Science and Technology, Faculty of Architecture and Design. Her main goal is to promote smart sustainable cities, through research, innovation and education.

Annemie leads several open innovation-based projects and platforms with the public and private sector in Norway, EU and China. Amongst others, she is Coordinator of the +CityxChange smart city lighthouse project, the EERA Joint Programme on Smart Cities, the Horizon Europe Norwegian Urban Partnership and the URBAN-NORWAY-CHINA Innovation Platform on Sustainable Urbanization. Annemie's projects/platforms typically aim to merge ambitions of clean energy in cities with sustainable, resilient, inclusive and safe communities (SDGs 11 and 7). The projects/platforms are created as safe spaces in which stakeholders from the public and private sector, academia and civil society can come together, discuss, test, fail, try again and eventually find good solutions for their local environment—a bridge that helps the experts and citizens to come together and innovate.

ABOUT THE REVIEW STAFF

Małgorzata Hanzl

Małgorzata Hanzl holds her MArch and PhD in Architecture and Urban planning from Lodz University of Technology, Poland. She completed her MArch diploma in Lyon Ecole d'Architecture. She received her habilitation from Faculty of Architecture, Warsaw University of Technology, Poland. She practiced urban planning and urban design as well as architecture for several years before entering academia and continues serving consultancy as urban planner.

An Assistant Professor of Urban Planning in Lodz University of Technology, Poland, she also teaches in Faculty of Architecture, Warsaw University of Technology, Architecture for Society of Knowledge MArch course. She has got an extensive experience in teaching and lecturing. She maintained her Fulbright Scholarship as a Visiting Researcher in SENSEable City Laboratory MIT, Cambridge MA.

Following her research interests she has been actively involved in publishing and writing activities, cooperating with several urban planning and citizen journals and blogging. Małgorzata's main area of interest and experience refers to public participation in urban planning, internet communication, GIS, rehabilitation especially in the context of post-industrial cities, urban morphology, anthropology and culture related studies. She is an author of several journal publications and also serves as a reviewer and an advisor in scientific boards and committees.

Jim Reilly

Jim Reilly worked as a City and Regional Planner for both private and public agencies. First, he was a member of the award-winning consulting firm of Wallace, McHarg, Roberts and Todd where he participate in hundreds of projects including the Plan for the Inner Harbor, in Baltimore, MD; route alignment and environmental impacts of the Metro Systems in Washington, DC and Baltimore, MD; and, the Plans for Abuja, the New Federal Capital of Nigeria. Then he worked as a senior planner and regional scientist for the State of New Jersey (USA) Office of State Planning and for the State of Maryland (USA) Department of Planning. While at these state agencies, Jim conducted statistical research about land use change and its impacts.

Jim has collaborated on scientific and engineering studies of hydrology and land use with the United States Geological Survey, the Department of Agriculture, the National Oceanographic and Atmospheric Administration, the EPA Bay Commission, and various State environmental protection and transportation agencies. His refereed publications have won awards from the American Institute of Planners, the International Society of City and Regional Planners, the European Union, and the American Water Resources Association.

Jim served his Country for 25 years as a medic in the US Army (Reserves) and is the recipient of 35 medals. He served in two wars and is a disabled veteran.

Jim and his wife, Fran Klass, enjoy each other, scuba diving, fly fishing, Wheaten Terriers, and travel.

Mahak Agrawal

Mahak Agrawal is a medical candidate turned urban planner, exploring innovative, implementable, impactful solutions for pressing urban-regional challenges in her diverse works. She is also a Shardashish Interschool Fellow and SIPA Environmental Fellow at Columbia University in the City of New York, studying public administration in environmental science and policy. In different capacities, Mahak has worked with the Intergovernmental Panel on Climate Change, Town and Country Planning Organization, Government of India, Institute of Transport Economics, Oslo, to name a few. In 2019, she founded Spatial Perspectives, using the power of visual storytelling and open data to dismantle myths and faulty perspectives associated with spaces around the world. Based out of India, Mahak spends spare time to experiment and create sustainable art works which showcase cultural heritage of India.

Ricardo Moura

Ricardo Moura is a graphic designer based out of Porto, Portugal. He completed his bachelors in graphic design from the Art and Design College (ESAD) in Matosinhos, Porto District, and later pursued a master degree in image design at the Faculty of Fine Arts of the University of Porto, where he focussed on the image and religion in a Portuguese anthropological context. He also pursued the master's course on teaching of visual arts at the University of Porto, emphasising through his works on the education processes vital to avoid visual pollution in public spaces. Recently, he pursued a Specialization in Scientific Illustration — Illustration in Natural Sciences — at the Faculty of Sciences of the University of Porto.

Presently, he teaches diverse courses of fashion design, textile design, and visual merchandising. Since 2008, he has been teaching at the Professional Training Centre for the Textile, Clothing, Apparel and Wool Industry (CITEX/MODATEX), and since 2016, he has been an educator at the Fashion School of Porto as well. He also works on various graphic design projects for book editions, conferences and symposiums, as well as research laboratories, corporate identities, and international organisation, including: International Society of City and Regional Planners (ISOCARP); Association of European Schools of Planning (AESOP); Institute of Construction (IC) and Department of Civil Engineering / Faculty of Engineering of the University of Porto (DCI/FEUP); Research Centre for Territory, Transports and Environment (CITTA).

ABOUT ISOCARP

The International Society of City and Regional Planners (ISOCARP) is a global association of experienced professional planners. It was founded in 1965 to create an international network of recognised and highly qualified planners. Today ISOCARP brings together more than 600 individual and institutional members from more than 85 countries worldwide. The wealth and diversity of professional expertise, knowledge, and experience in the ISOCARP membership are unmatched in the planning field.

Although ISOCARP members work in many different urban and territorial planning fields, they all share a common interest in the spatial, sociocultural, economic, and environmental dimensions of urbanization and broader territorial sustainability. ISOCARP members advise key decision-makers, proposing and supporting projects for intervention in a spatial context through general or specific actions.

The objective of ISOCARP is to improve cities and other territories through planning practice, training, education, and research.

ISOCARP encourages the exchange of professional knowledge between planners, promotes the planning profession in all its forms, stimulates and improves planning research, training, and education and enhances public awareness and understanding of major planning issues at a global level.

As a non-governmental organisation, ISOCARP is recognized by the United Nations (UN), the United Nations Human Settlements Programme (UN-Habitat), and the Council of Europe. ISOCARP is a lead partner with UN Habitat's World Urban Campaign and the Habitat Professionals Forum. The Society also has a formal consultative status with the United Nations Education, Scientific and Cultural Organization (UNESCO). Furthermore, in 2017 ISOCARP, together with other global partners, initiated the UN-Habitat's Planners for Climate Action (P4CA). Today P4CA, together with UN-Habitat and Cities Alliance, constitute organizations with over 80,000 members and contributes to the OECD National Urban Policy programme (NUPP). ISOCARP also advises OECD on global planning policies to mitigate the COVID-19 pandemic health and related economic crisis.

In addition to its organizational work, the Society has a robust range of activities. The Society's main event is the annual **ISOCARP World Planning Congress**. Since 1965, ISOCARP Congresses have taken place in all parts of the world providing a forum to explore and engage with cutting edge topics. These Congresses promote and encourage knowledge creation and sharing within the planning profession. Also, the Society undertakes a robust range of professional activities. A particular focus and commitment of ISOCARP is facilitating knowledge for better cities with the youth. The **Young Planning Professionals (YPP)** workshops is a crucial component of ISOCARP's commitment to contribute to the knowledge base and skills of young professionals, the future leaders of our profession. The YPP Programme seeks to bring together emerging young (under the age of 35) planners from all over the world to tackle 'real-world' planning projects.

ISOCARP **Urban Planning Advisory Teams (UPATs)** assist cities and regions by offering the extensive experience and expertise of ISOCARP members to work on important local or international planning projects, programs, and policy initiatives.

ISOCARP recognizes excellence through the **Society's Awards programme**.

In response to specific requests for ISOCARP assistance with research and consulting services, ISOCARP forms **Technical Assistance Teams** consisting of members who volunteer their expertise and experience.

In 2016, ISOCARP officially established the research spin-off **ISOCARP Institute – Centre for Urban Excellence**, as the formal body for generating, documenting, and disseminating knowledge for better cities. The Institute's core function is to design and deliver capacity building and continuing education programs; conduct research and promote knowledge transfer; as well as offer advice and short-term consultancy services to government, non-government and international bodies worldwide. The three main activities of the Institute – projects, research, and academy – encompass, facilitate and strengthen some of ISOCARP's core activities while expanding it by additional research and advisory projects.

Finally, 'thanks' to the COVID-19 pandemic crisis, ISOCARP's Cyber Community has more rapidly matured with a wide spectrum of old and new cyber activities for members and non-members, including many web-based Urban Thinkers Campuses and other webinars, public Cyber Agora events, virtual Communities of Practices & Research, and last but not least our expanding 'Planetary' including three websites (Society, Institute and Congress) and all related social media.

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ISOCARP
Knowledge for Better Cities

ISOCARP	International Society of City and Regional Planners
AIU	Association Internationale des Urbanistes
IGSRP	Internationale Gesellschaft der Stadt- und Regionalplaner
AIU	Asociación Internacional de Urbanistas

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