

Building Regulations and Urban Policies as Incentives for Application of District Cooling Systems in Singapore

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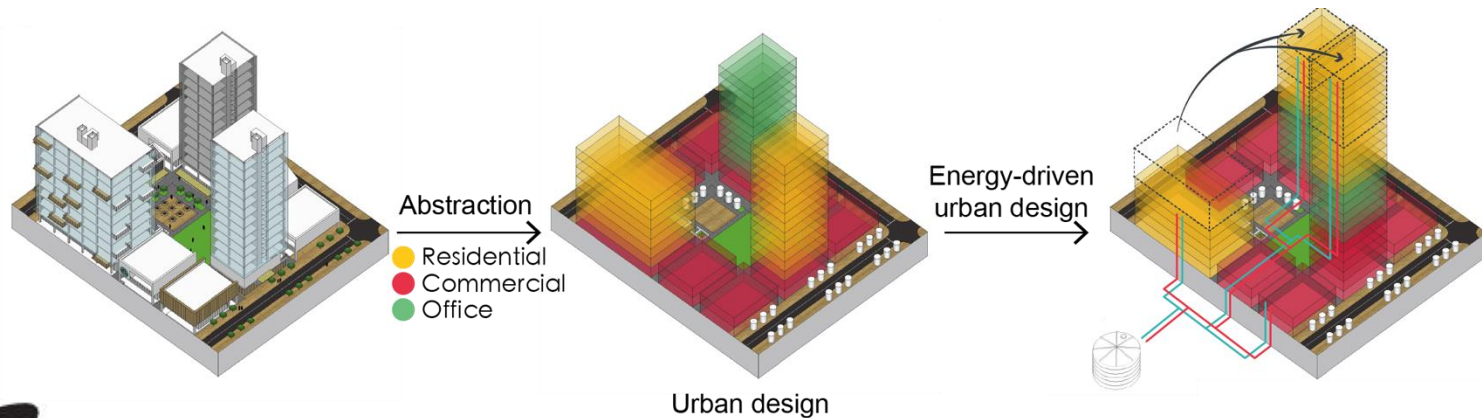


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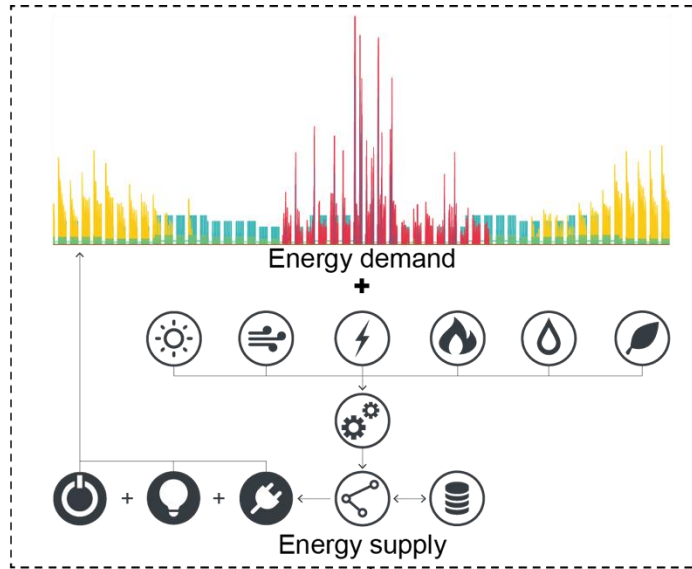


Larger Scope

Energy-driven urban design aims at providing urban configurations that decrease energy demand, particularly consider and respond to the interdependencies between the energy systems and the urban form for higher energy performance.

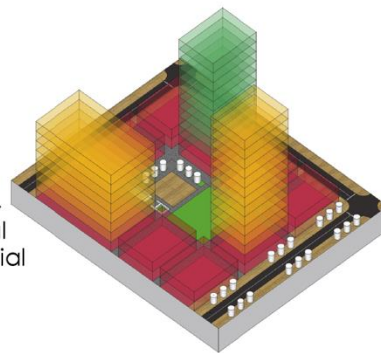


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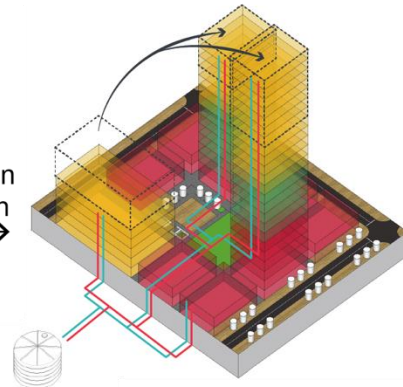
Abstraction

- Residential
- Commercial
- Office



Urban design

Energy-driven urban design



Larger Scope

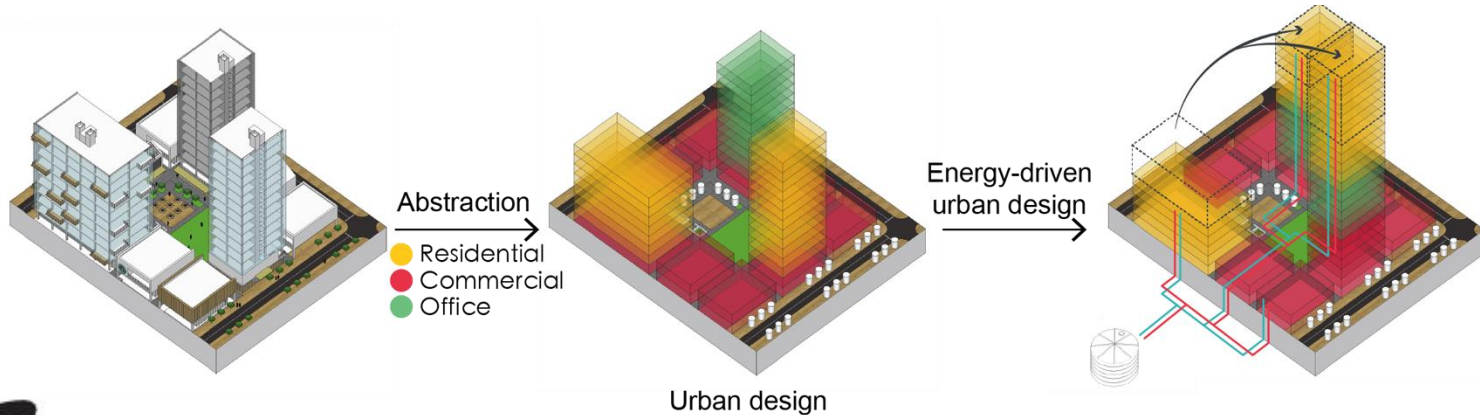
Interdependencies



Urban design guidelines



Applicability of this concept in design in the existing mode of urban development in Singapore



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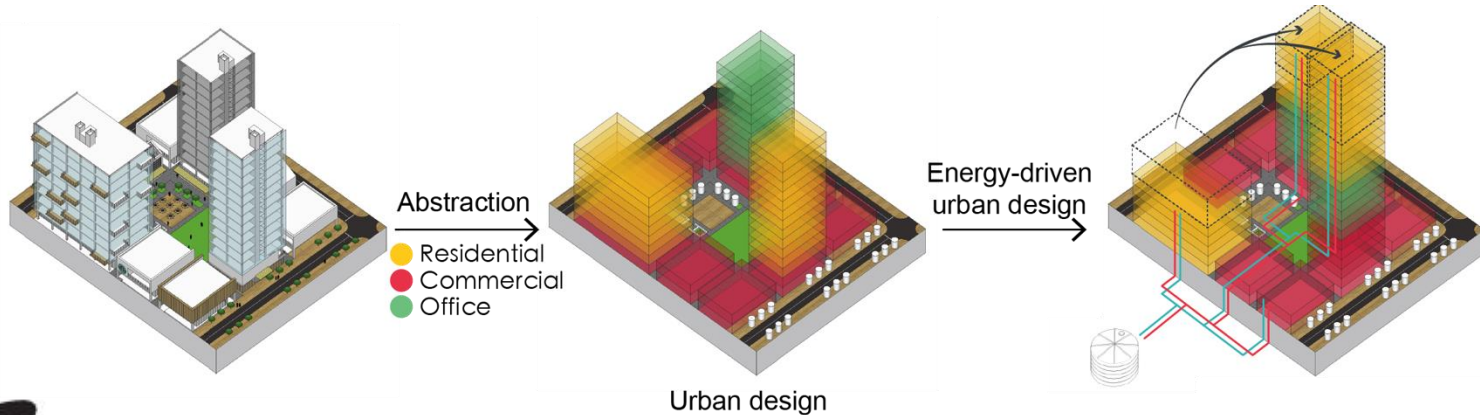
Interdependencies



Urban design guidelines



Applicability of this concept in design in the existing mode of urban development in Singapore: policy matters.



Background

- The global trend calls for serious and responsible actions on carbon emission reduction.
- Singapore has pledged to reduce CO₂-emissions by 36% in 2030 at COP21 (Ho 2015).
- District cooling systems (DCS) offer a solution for better energy performances as well as resilience-related, economic and environmental benefits (UNEP 2014).
- There are multiple DCS plants in Singapore. As part of a special urban policy for the development of the Marina Bay Business District, most buildings in the area are mandatorily required to connect to DCS (Zhuang 2016).



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DCS' influence on aspects of urban design

Space saving - the space freed up by removing cooling facilities from the building rooftops and basements. It improves aesthetic and efficiency of the building and the city. Cooling towers on the rooftop can be replaced by sky gardens or terraces; chillers in the basement can be replaced by interconnected underground pedestrian tunnels.

For example, the ship-like infinity pool floating over the three towers of Marina Bay Sands would not be realized without the DCS.



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DCS' influence on aspects of urban design

Noise reduction - the removal of cooling facilities takes the noises away from the urban environment especially street canyons.

Building program (land uses) - DCS desires a stable consumption of the cold produced. Offices, for example, consume mainly in the daytime while residential buildings consume mainly at night. Thus, to maintain a stable and constant consumption pattern throughout the day, a mixed-use of various building programs with various types of occupancy, usage, time-of-the-day and weather conditions is beneficial (Tey 2010; Fonseca & Schlueter 2016).



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Research Question

- What is the **role** and the **status quo** of planning and building regulations and relevant urban policies on the application of DCS in Singapore?
- What **changes** can be made that may improve the efficiency of DCS and incentivize developers and proprietors to consider such system?



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Methodology

- **Direct incentives** - the incentives directly applied for the adoption of district cooling systems.
 - **Indirect incentives** - the incentives benefiting from the results of the DCS's influence on various aspects of the building projects.
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- A review of the incentives initiated by the governmental authorities in Singapore, including BCA (Building Construction Authority) and URA (Urban Redevelopment Authority)
 - A roundtable discussion on DCS. Participants include academic researchers and DCS providers in Singapore and China.



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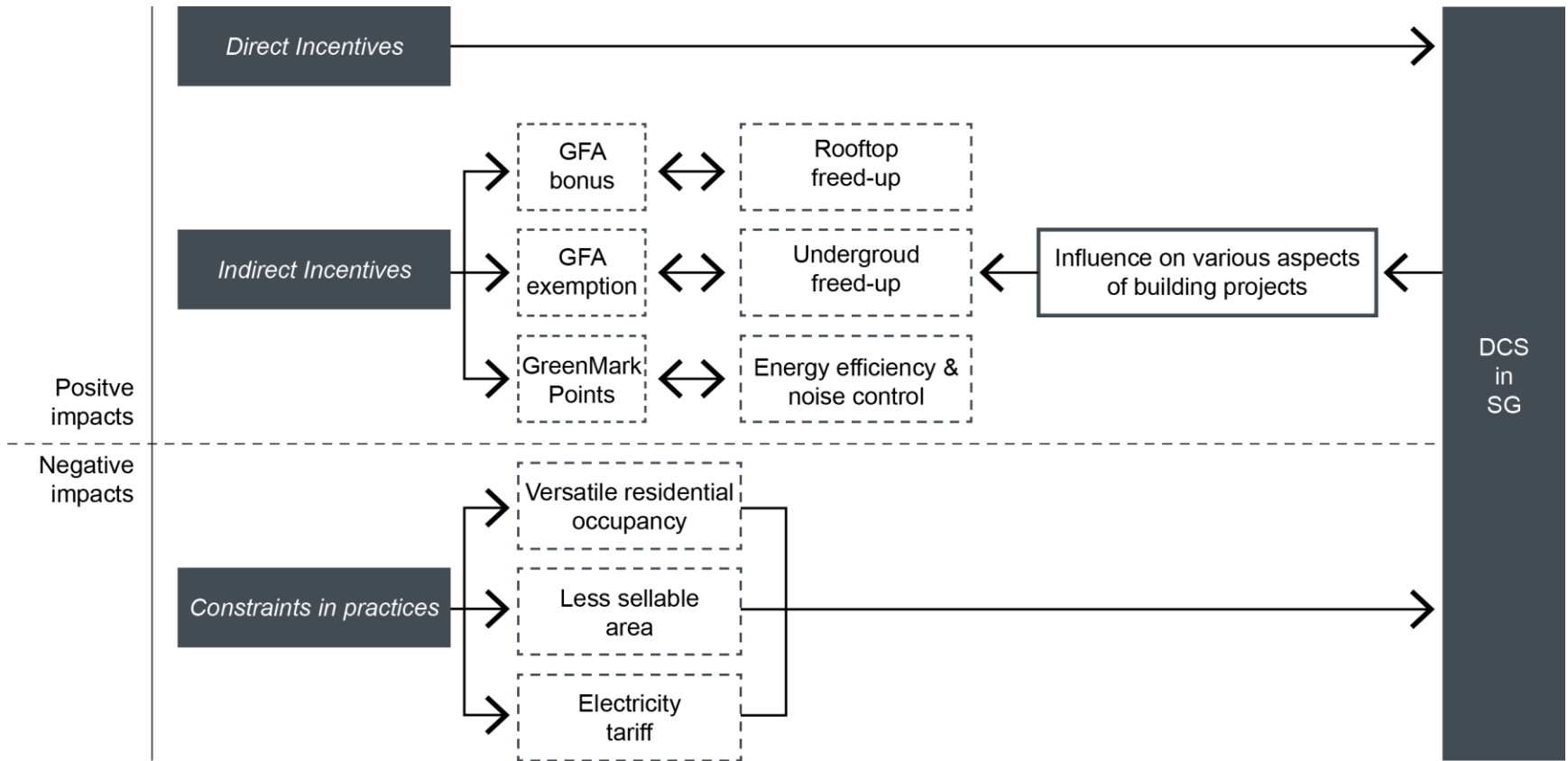
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Results



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Discussions

- ***Interdependencies on different levels.*** Various levels of urban development, e.g. urban planning and design, building design. Various stakeholders, e.g. governmental authorities, designers, developers, cooling providers, customers
- ***Residential or not?*** Decisions by stakeholders from various points of view.



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Conclusions

- The application of DCS is **multifaceted** and more than merely a technical, a commercial or a policy issue.
- **Policy matters.** Building regulations and urban policies can work as direct or indirect incentives to promote voluntary connections. However, any adaptations of such regulations and policies should be carefully evaluated before coming into force.



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Outlook

- Future studies on district cooling systems will include ideas, and experiences from all the stakeholders involved in the lifespan of a building project. This includes cooling providers, policy-makers, developers and district cooling customers.
- Beyond DCS, similar studies concerning policies can be extended to other energy technologies.



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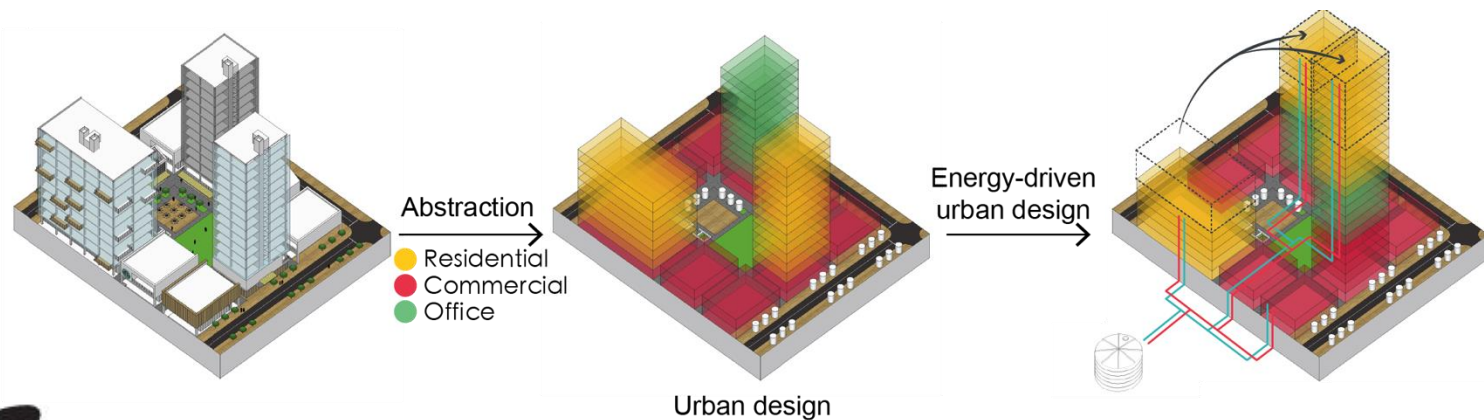


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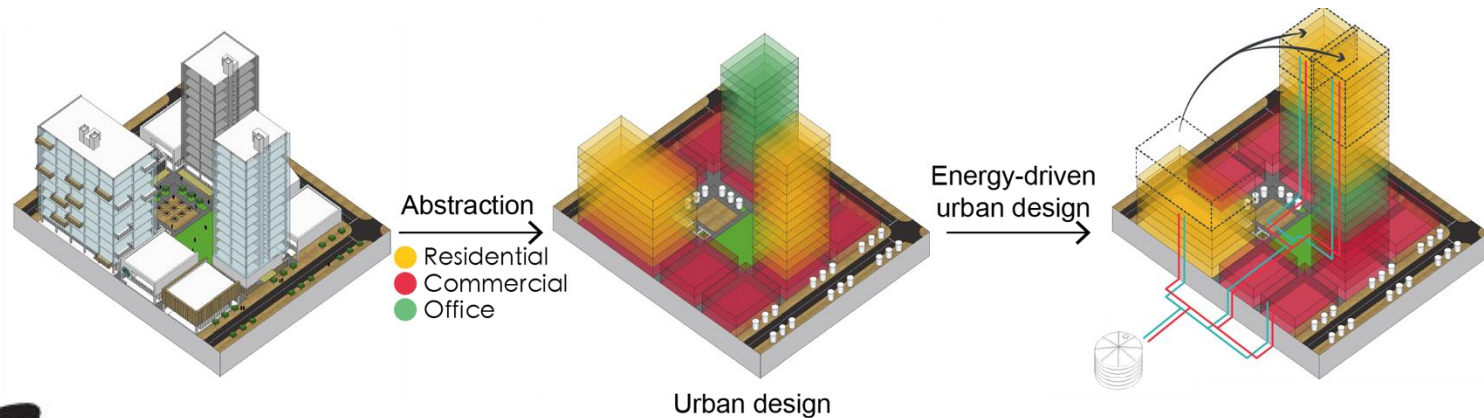


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Applicability of this concept in design in the existing mode of urban development in Singapore: **Policy Matters!**



Applicability of this concept in design in the existing mode of urban development in Singapore: **Policy Matters! Benefits for all matter!**



Thank you!

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References

- [1] Ho, O 2015, 'Spore calling for universal climate deal', *Strait Times*, 21 November. Available from: <http://www.straittimes.com/singapore/spore-calling-for-universal-climate-deal>.
- [2] UNEP 2015, 'District energy in cities: Unlocking the potential of energy efficiency and renewable energy'.
- [3] Tey PK 2010, 'District cooling as an energy and economically efficient urban utility-its implementation at Marina Bay Business District in Singapore.' Available from: [http://www.singaporepower.com.sg/irj/go/km/docs/wpccontent/Sites/Singapore%20District%20Cooling/Site%20Content/Overview/documents/DCS%20Paper%20\(Jun%202010\).pdf](http://www.singaporepower.com.sg/irj/go/km/docs/wpccontent/Sites/Singapore%20District%20Cooling/Site%20Content/Overview/documents/DCS%20Paper%20(Jun%202010).pdf).
- [4] Fonseca J & Schlueter A 2016, 'Assessing the performance and resilience of future energy systems at neighbourhood scale', *Expanding Boundaries: Systems Thinking in the Built Environment: Sustainable Built Environment (SBE) Regional Conference Zurich*, pp. 96-100.
- [5] Zhuang, J 2016, 'Keeping Marina Bay Cool', *Skyline*, Issue 04, pp. 10-13.
- [6] Olubunmi, A, Xia, B & Skitmore, M 2016, 'Green building incentives: a reivew', *Renewable and Sustainable Energy Reviews*, 59, pp1611-1621.
- [7] Brilhante, O & Skinner, J 2015, 'Review of some incentive mechanisms being used by some European Municipalities to promote sustainable housing.' Available from: http://www.ihs.nl/fileadmin/ASSETS/ihs/Marketing/prospective_students_pages/ECO_and_MFU/Incentive_mechanism_municipalities_sustainable_construction.pdf
- [8] Shapiro Shari 2001, 'Code green: Is "greening" the building code the best approach to create a sustainable built environment?' *Planning & Environmental Law*, 63.6 pp. 3-12.
- [9] BCA 2009, 'Green Mark Incentive Scheme', available from: https://www.bca.gov.sg/GreenMark/others/Guideline_for_Green_Mark_Cash_Incentive_Scheme_v3.pdf.
- [10] URA 2014, 'An overview of the LUSH Programme', available from: www.ura.gov.sg/-/media/User%20Defined/URA%20Online/media-room/2014/jun/pr14-35a.pdf?la=en.
- [11] URA 2016a, 'Key urban design elements', available from: <https://www.ura.gov.sg/uol/urban-planning/vision/Key.aspx>.
- [12] URA 2016b, 'Development control parameters for residential development', available from: <https://www.ura.gov.sg/uol/publications/technical/dc-handbooks/dc-parameters-for-residential-development>.
- [13] URA 2016c, 'Development control parameters for non-residential development', available from: <https://www.ura.gov.sg/uol/publications/technical/dc-handbooks/dc-parameters-for-non-residential-development>.
- [14] URA 2001, 'Guidelines for Underground Pedestrian Links to Rapid Transit System (RTS) Stations', available from: <https://www.ura.gov.sg/uol/circulars/2001/may/dc01-13.aspx>.
- [15] BCA 2013, 'Framework-BCA Green Mark for residential buildings (Version RB/4.1)', available from: https://www.bca.gov.sg/GreenMark/others/gm_resi_v4.1_R.pdf.
- [16] BCA 2016, 'About BCA Green Mark Scheme', available from: https://www.bca.gov.sg/GreenMark/green_mark_buildings.html.
- [17] URA 2009, 'Green Mark gross floor area incentive scheme for private developments that achieved higher-tier Green Mark ratings', available from: www.ura.gov.sg/uol/circulars/2009/apr/dc09-04.aspx.
- [18] Happle, G 2016, video recording, 'Roundtable on challenges of future district energy in Singapore', Singapore.
- [19] Cajot, S, Schlueter, N, Peter, M, Page, J & Marechal, F 2016, 'Establishing links for the planning of sustainable districts', *Expanding Boundaries: Systems Thinking in the Built Environment: Sustainable Built Environment (SBE) Regional Conference Zurich*, pp. 502-512.
- [20] Jacobs, J 1961, *The death and life of great American cities*, New York.



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