

SINO-U.S. ECO URBAN LAB
CUTTING-EDGE RESEARCH FOR
SHAPING SUSTAINABLE URBAN
SYSTEMS

中美生态城市设计实验室
形塑可持续城市系统的前沿研究

SINO-U.S. ECO URBAN LAB

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Managing Director (Shanghai Lab)

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Lab Manager (Shanghai Lab)

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ACADEMIC BOARD

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Dean, College of Architecture, Georgia Institute of Technology

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Professor, School of City and Regional Planning, Georgia Institute of Technology

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Professor, Department of Urban Planning, College of Architecture and Urban Planning, Tongji University

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Assistant Professor, School of Mechanical Engineering, Tongji University

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Shi Zhongming

Research Assistant, College of Architecture and Urban Planning, Tongji University

Yang Tianren

Research Assistant, College of Architecture and Urban Planning, Tongji University

全球城市碳排放及能耗評估比較分析

GLOBAL CITIES BENCHMARKING ON CARBON FOOTPRINT

(Project selected by ACSA 100 meeting at MIT, 2012)



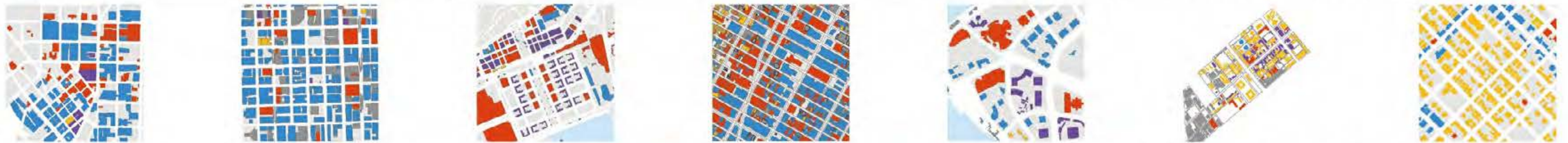
BUILDING DENSITY

0 2.5 far/2.5 5 far/5 10 far/10 20 far/20+ far (Legend)



LAND USE

Other/ Commercial/ Office/ Residential/ Mixed Use (Legend)



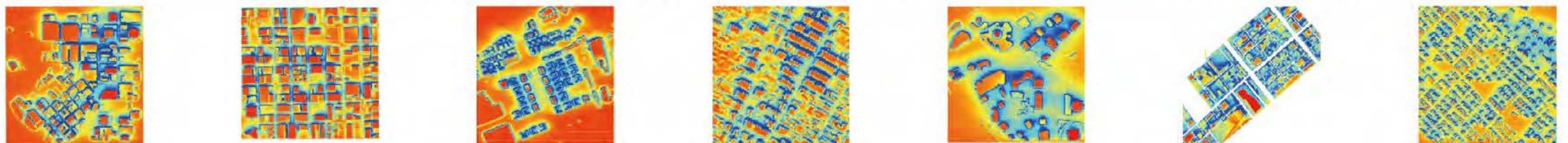
CARBON EMISSION

0 1 1000 1001 2000 2001 3000 3001 4000 4001 5000 5001 10000 10001 15000 15001 20000 20001 25000 25001 30000 30001 40000 40001 50000 50001 60000 60001 70000 70001 80000 80001 90000 90001 100000 (units: metric tons)



SOLAR RADIATION

High: 1.69351e+006 Low: 11.781 (Units: WH/m²) Available Solar Radiation: 0 50000 50001 100000 100001 200000 200001 300000 300001 400000 400001 500000 500001 1000000 1000001 2000000 2000001 5000000 5000001 (units: kWh)

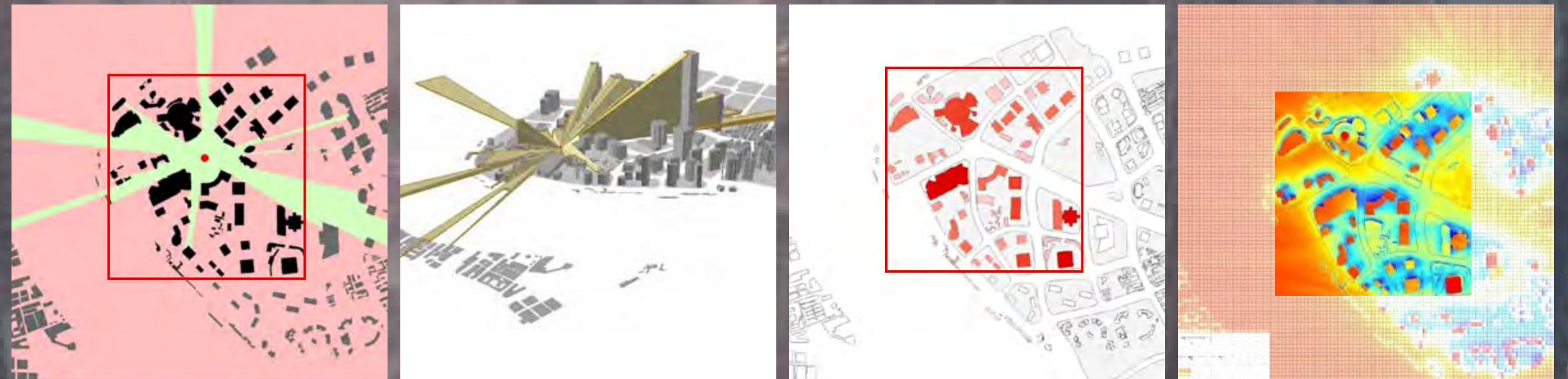


70,425,274 kWh/km ² 519,293 tons 37,678 tons	51,022,520 kWh/km ² 1,853,772 tons 50,599 tons	44,040,081 kWh/km ² 556,936 tons 29,214 tons	2,347,177,054 kWh/km ² 1,815,579 tons 58,277 tons	60,848,848 kWh/km ² 756,756 tons 20,607 tons	188,861,571 kWh/km ² 169,467 tons 18,045 tons	17,847,168 kWh/km ² 187,951 tons 9,473 tons	Total Solar radiation CO ₂ Emissions based on Land Use Total Carbon offset by Solar
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亞洲城市核心區減碳力研究

BENCHMARKING CARBON -ENERGY EFFICIENCY OF ASIAN DOWNTOWNS

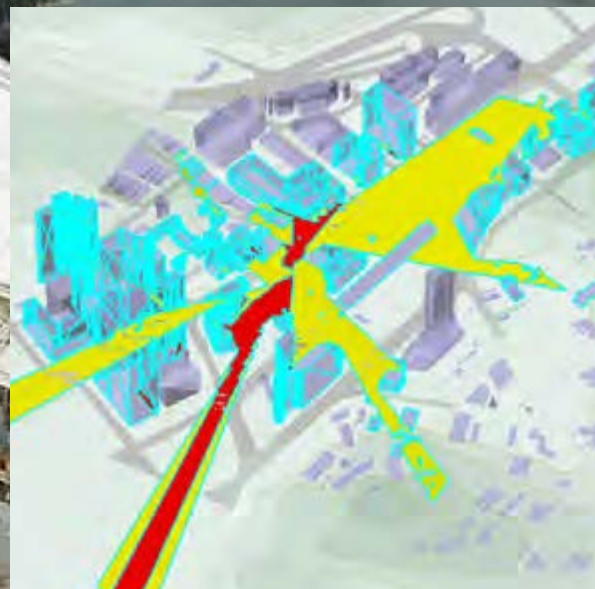
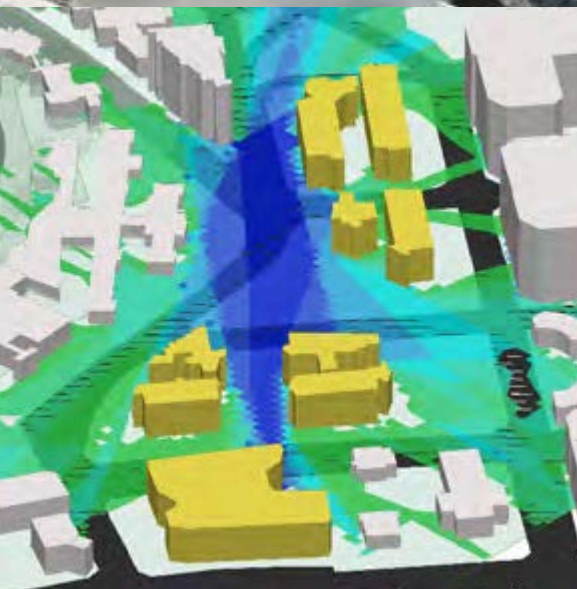
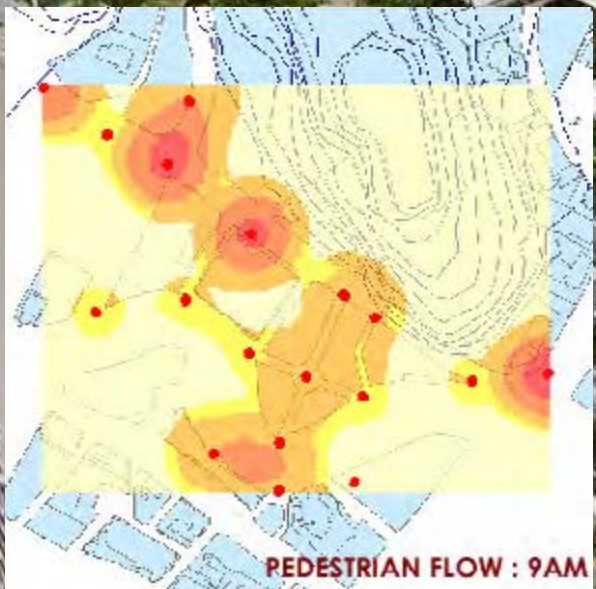
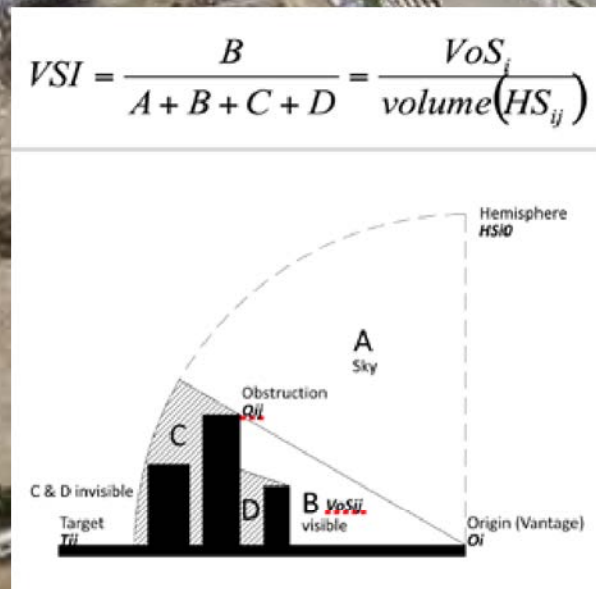
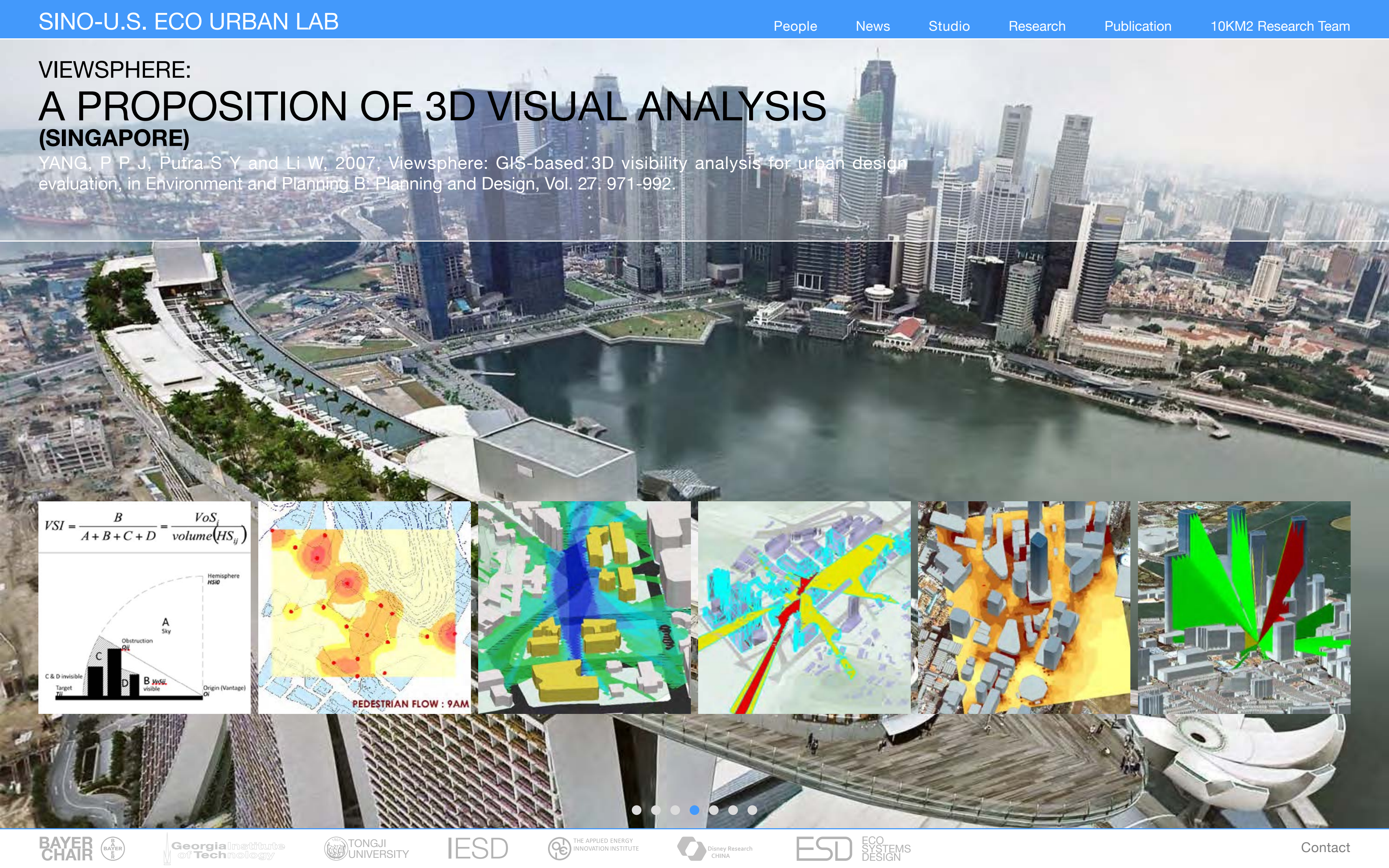
(Global Carbon Project+ Eco Urban Lab, 2014-)



VIEWSPHERE:

A PROPOSITION OF 3D VISUAL ANALYSIS (SINGAPORE)

YANG, P P J, Putra S Y and Li W, 2007, ViewspHERE: GIS-based 3D visibility analysis for urban design evaluation, in Environment and Planning B: Planning and Design, Vol. 27. 971-992.

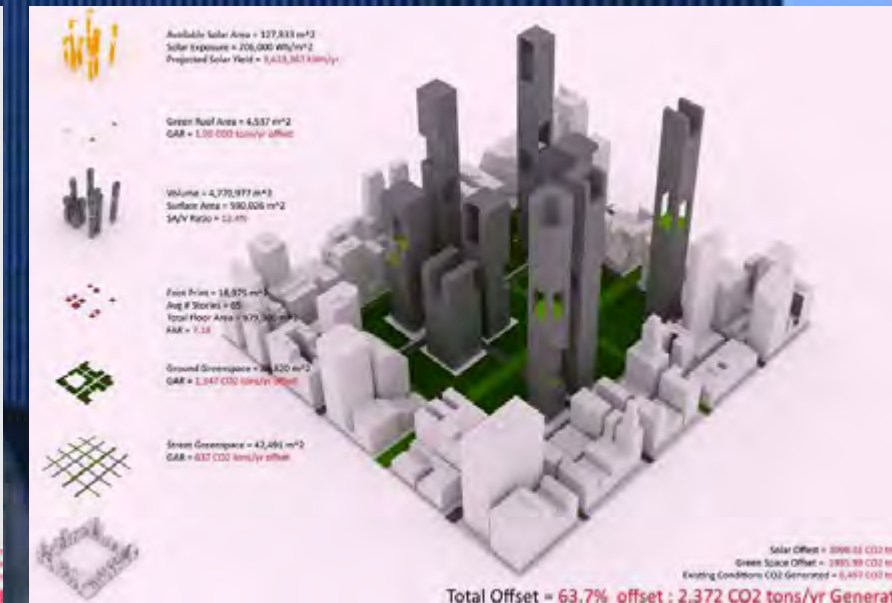


A DESIGN-DRIVEN URBAN MODELING: FROM SCIENCE FOR DESIGN TO DESIGN IN SCIENCE (CHICAGO LOOP)

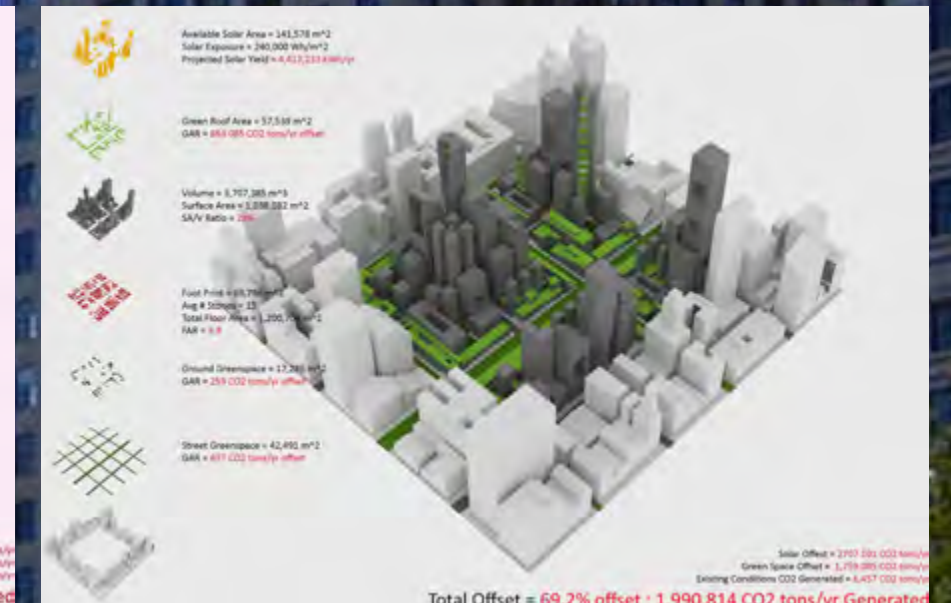
By redesigning a current urban form structure (Figure 2a) and by maximize its “solar envelop” along the street front, the urban energy performance can be enhanced by 63.7% (Figure 2b) or 69.2% (Figure 3c) in total carbon reduction through adding the reduction of energy consumption and the increase of renewable energy gain.



a



b

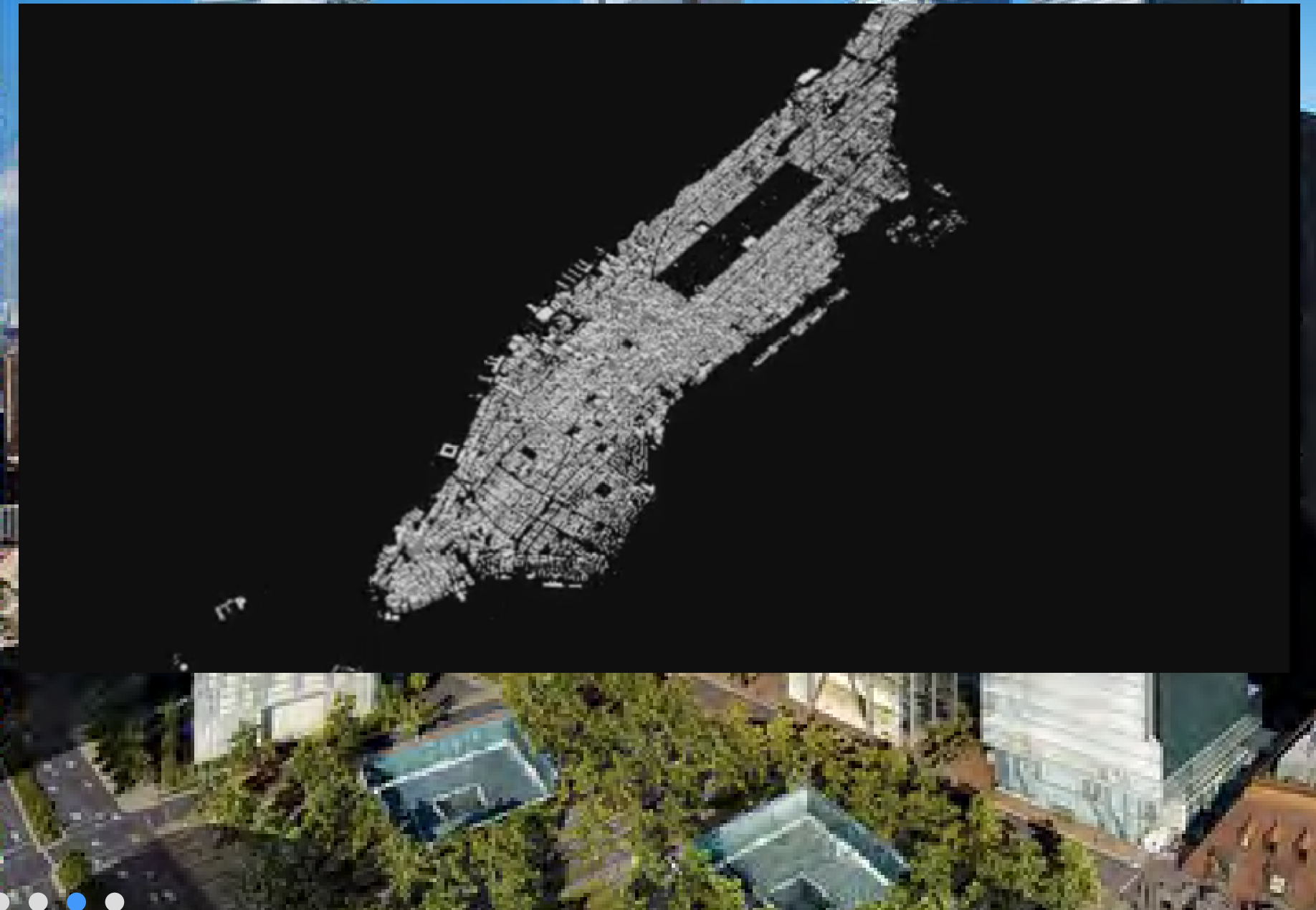
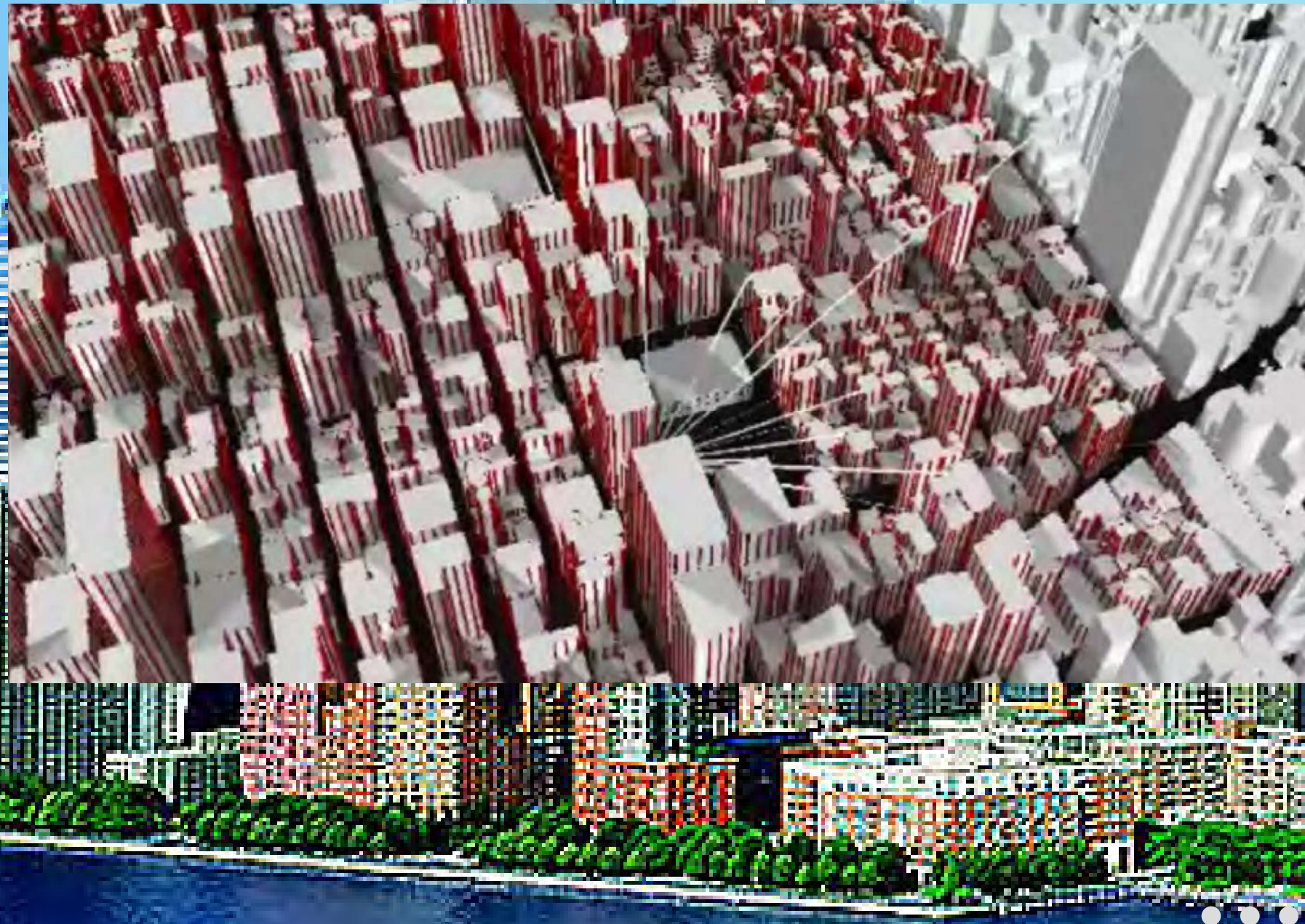


c

Fig. 2. A focal scale urban modeling for energy performance [17]:
(a) existing; (b) 63.7% carbon reduction; (c) 69.2% carbon reduction (Yang, 2013)

URBAN BUILDING ENERGY MODELING SYSTEM (NEW YORK)

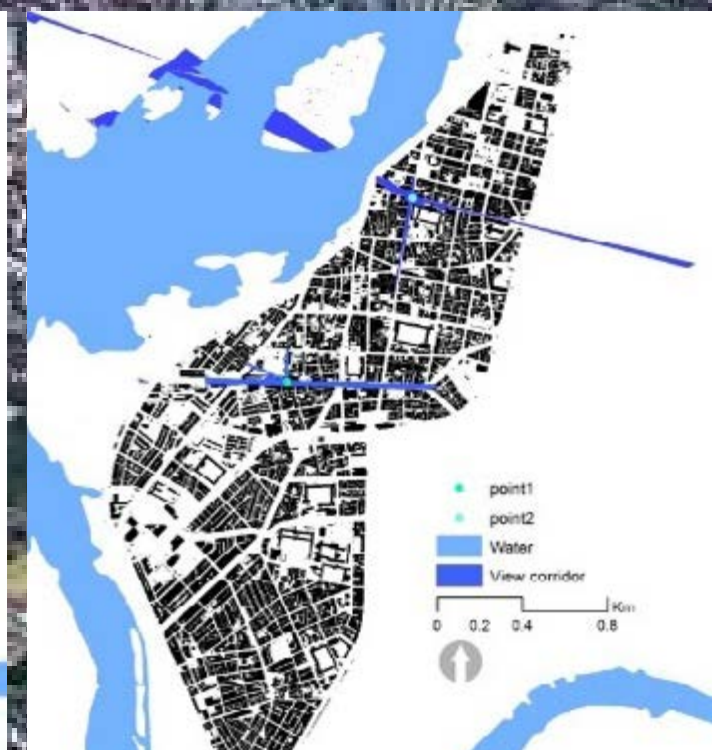
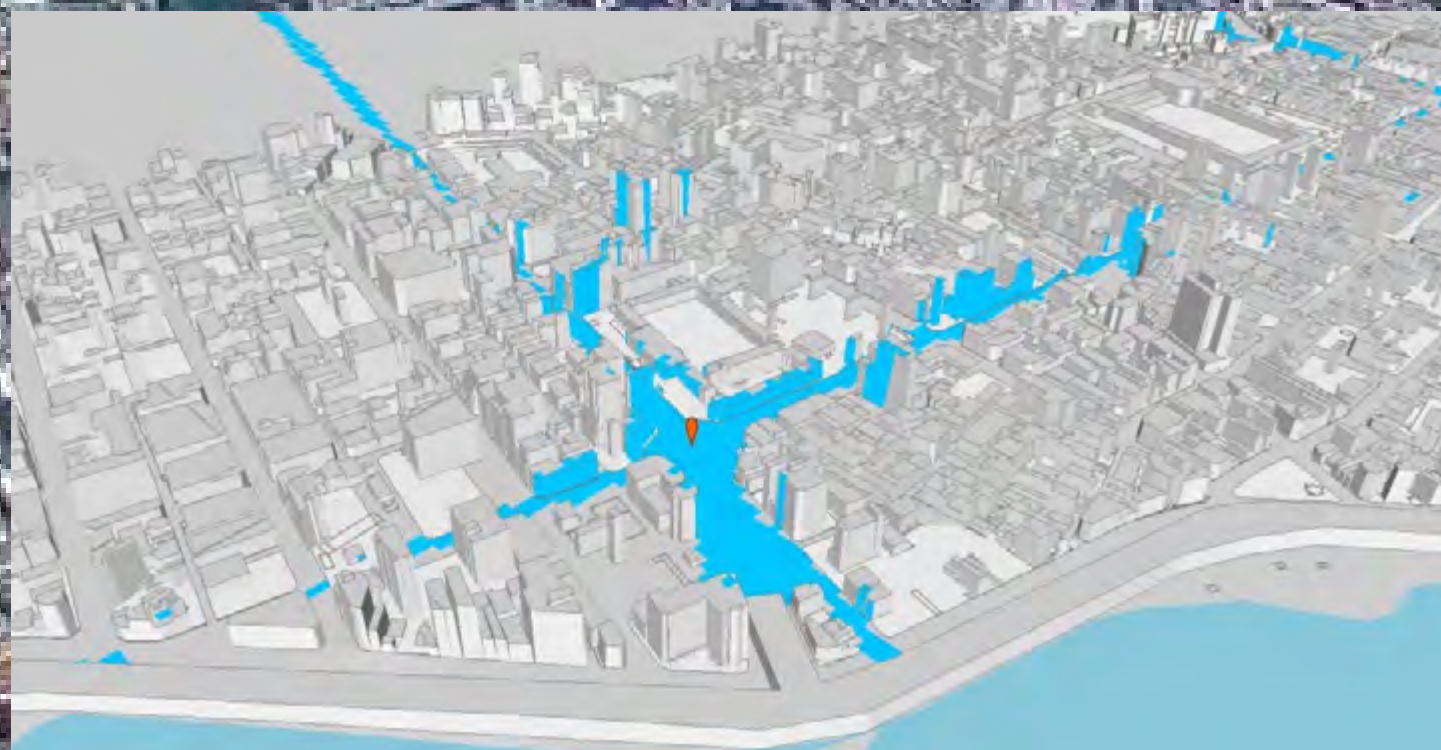
Quan, Steven J., Li Q., Augenbroe, G., Brown, J., Yang, Perry P. J.* (2015), Urban Data and Building Energy Modeling: A GIS-Based Urban Building Energy Modeling System Using the Urban-EPC Engine, in Planning Support Systems and Smart Cities, Geertman S. et al. (eds.), Springer.



EAR (ECO AREA RATIO)

AN ENERGY PLANNING TOOL FOR ECOLOGICAL URBAN REVITALIZATION AND TRANSFORMATION (TAIPEI)

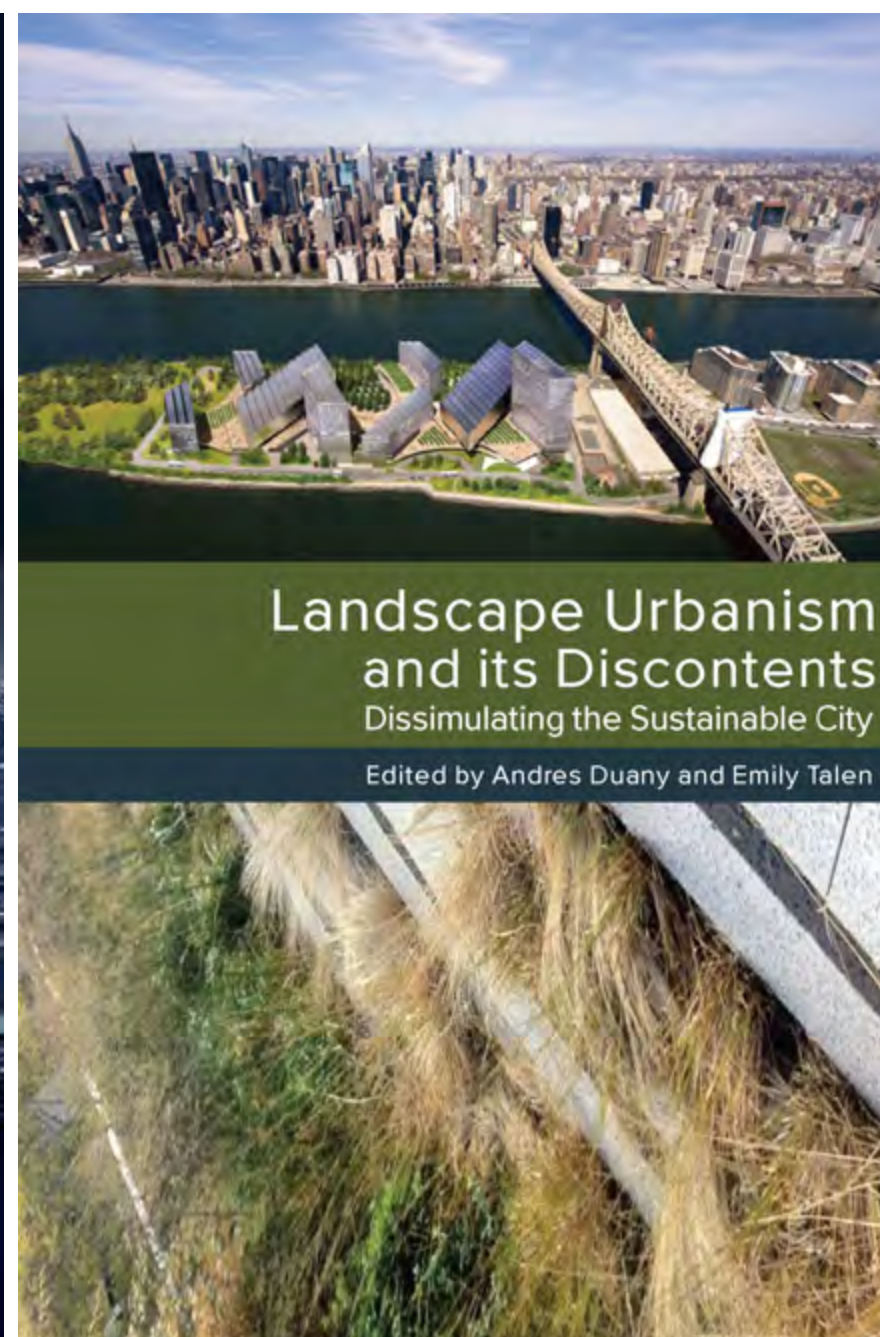
Yang, Perry P J, 2013, in Wicked Problem Symposium, organized by the Journal Landscape and Urban Planning, College of Environmental Design, UC Berkeley, October 2013



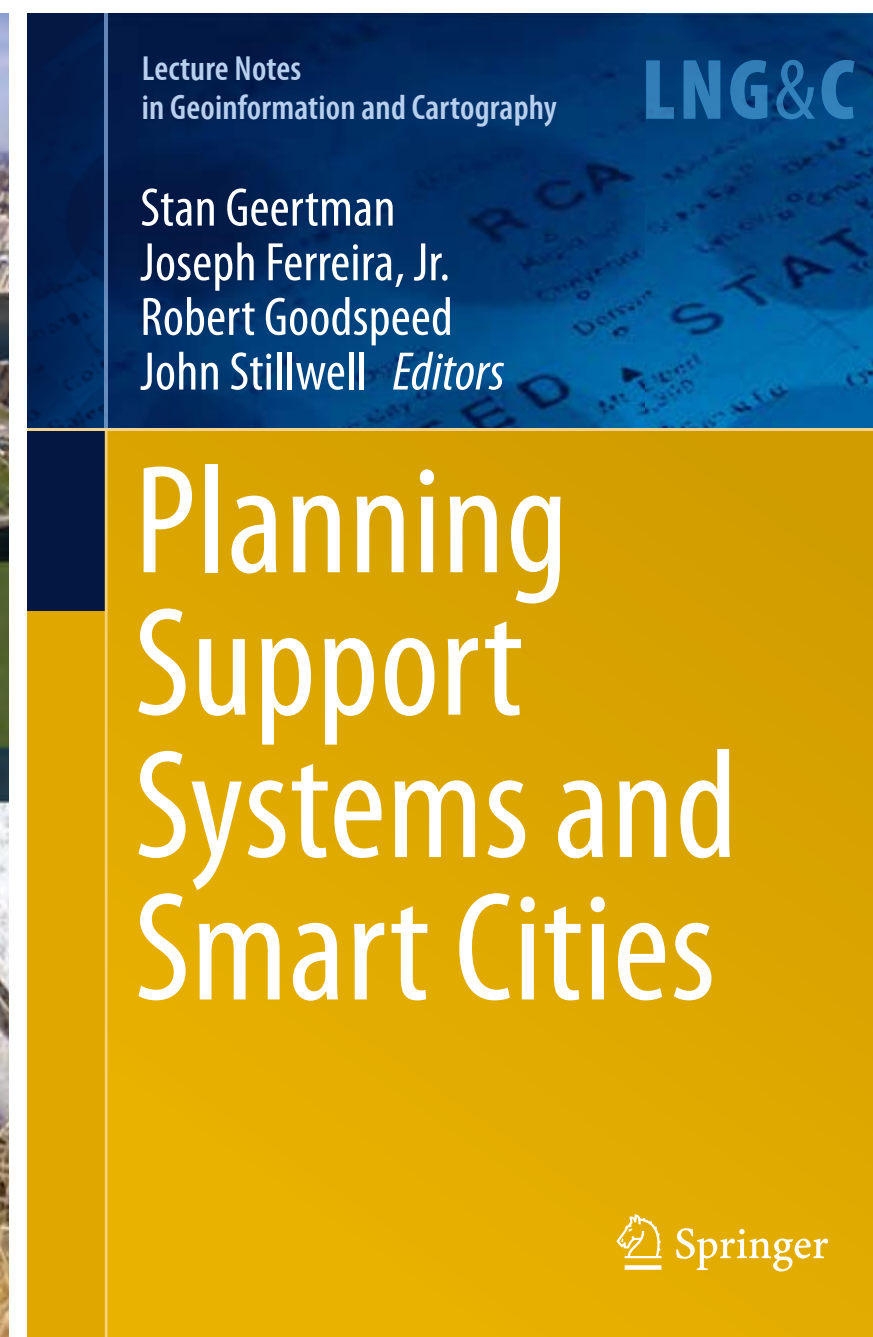
RECENT PUBLICATIONS FROM ECO URBAN LAB



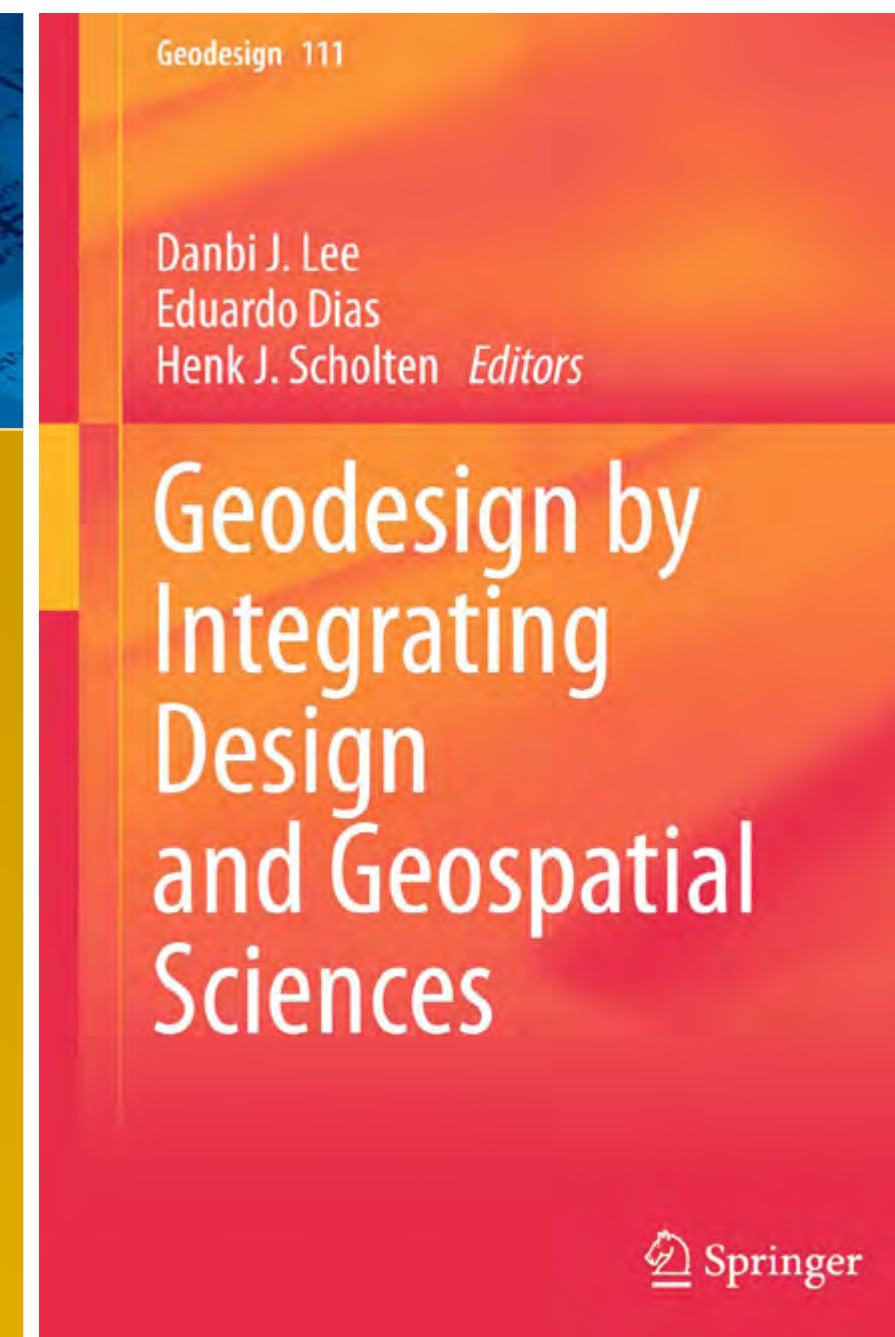
Yang, P P J, (2010) Ecological Urbanism: Scale, Flow and Design, China Architecture and Building Press.



Yang, Perry P. J. (2013) "Landscape ecology and its urbanism" in Landscape Urbanism and its Discontents: Dissimulating the Sustainable City. Andres Duany and Emily Talen eds., Island Press.



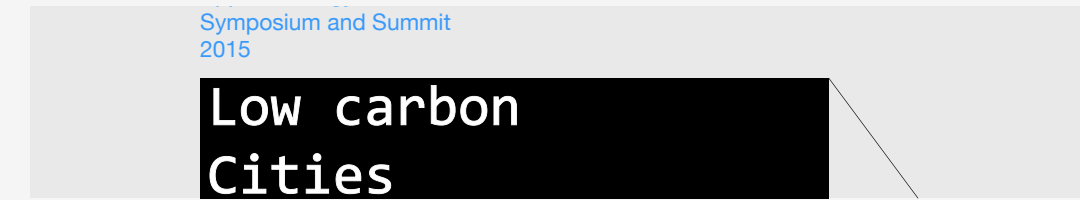
Quan, Steven J., Li Q., Augenbroe, G., Brown, J., Yang, Perry P. J.* (2015), Urban Data and Building Energy Modeling: A GIS-Based Urban Building Energy Modeling System Using the Urban-EPC Engine, in Planning Support Systems and Smart Cities, Geertman S. et al. (eds.), Springer.



Yang, Perry P. J. (2014) "Energy resilient urban planning", in Geodesign by Integrating design and geospatial sciences, Lee D and Dias E, Scholten H eds., Springer.



3 Low Carbon Cities and Urban Energy Symposium



2 Shanghai International Urban Design Forum
2015 International Symposium on Eco Urban Design



1 Opening of the Sino-US Eco Urban Lab at Tongji
University, January 2014



Low Carbon Cities and Urban Energy Symposium

Applied Energy Innovation Institute (AEii)
Sino-U.S. Eco Urban Lab Bayer Chair of UNEP-Tongji IESD

Applied Energy
Symposium and Summit
2015

Low carbon Cities and Urban Energy Systems (CUE²⁰¹⁵)

November 15-17, 2015
Fuzhou, Fujian, China

The CUE2015, with the theme of “power your city with clean, affordable & reliable energy”, will bring leaders in the sectors of energy, urban design, engineering, infrastructure systems, city planning, real estate development, public policy and related stakeholders in two-day symposium and one-day summit to share the most recent progress of research on urban energy systems and their challenges, and discuss how the future urban energy systems can be designed and implemented. The topics cover energy supply, distribution, and end use; smart eco-cities, urban transportation with efficient energy and low emissions; microgrid and smart home; BIPV and renewable applications; urban waste to energy; nexus of energy-water; policy options etc.

All papers will be peer reviewed before being accepted for the Applied Energy Symposium: Low carbon cities and urban energy systems (CUE2015). All accepted papers must be presented in person at the CUE2015. The scientific committee will recommend some of the presented papers for the further consideration of the special issue of CUE2015 in Applied Energy (Impact Factor: 5261).

Call for Paper



- For more information, please visit
<http://www.applied-energy.org/cue2015/index.html>
- Register as a delegate – [HERE](#)
- Submit papers before July 30, 2015
http://www.applied-energy.org/cue2015/uploads/Call%20for%20Papers_20150423.pdf



Shanghai International Urban Design Forum

2015 International Symposium on Eco Urban Design



Shanghai International Urban Design Forum
2015 International Symposium on Eco Urban Design

Venue: College of Architecture and Urban Planning, Tongji University
June 5: Room 106, Wenyuan Building, CAUP
June 6: D3 Auditorium, Building D, CAUP

Organizers:

College of Architecture and Urban Planning, Tongji University
College of Architecture, Georgia Institute of Technology
Sino-U.S. Eco Urban Lab

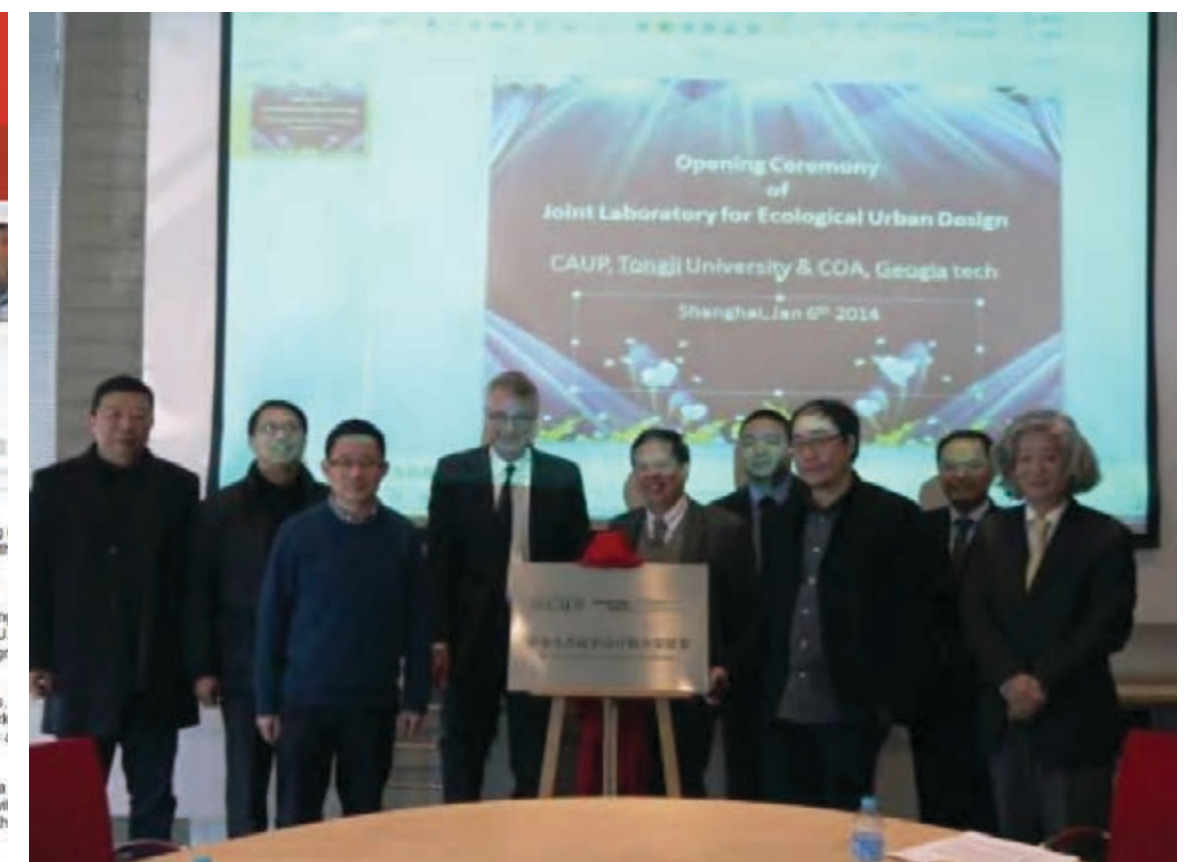
Co-organizers:

Bayer Chair of UNEP-Tongji Institute of Environment for Sustainable Development
Urban Planning Forum, Urban Planning International, Time Architecture (TA),
Modern Smart City

<http://udshanghai.org>

Opening of the Sino-US Eco Urban Lab at Tongji University, January 2014

College of Architecture, Georgia Institute of Technology
 College of Architecture and Urban Planning, Tongji University



6 Chongming Island ECO-CITY 2.0 Workshop 2015



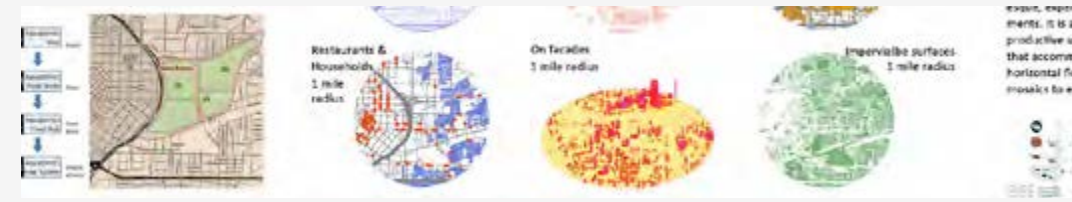
5 SUIDONG Bay Eco Urban Design



4 Strategic Planning for Kaohsiung's Free Economic Zone and New Asian Bay Area 2013



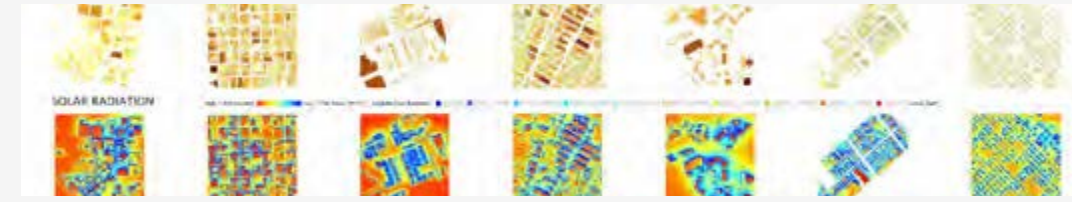
3 A Low Energy Urban Agriculture System at Wheat Street Garden in Atlanta 2012



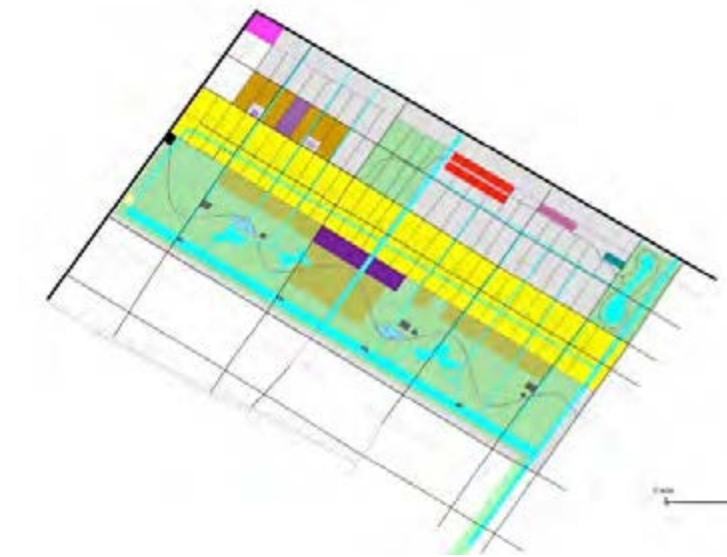
2 CP8823PY/ ARCH8823 Site Planning and Urban Ecosystems Simulation 2012+2013



1 Ecological Urbanism Studio: GLOBAL BENCHMARKING for LOW CARBON URBAN DESIGN 2011



Chongming Island ECO-CITY 2.0 Workshop 2015



4



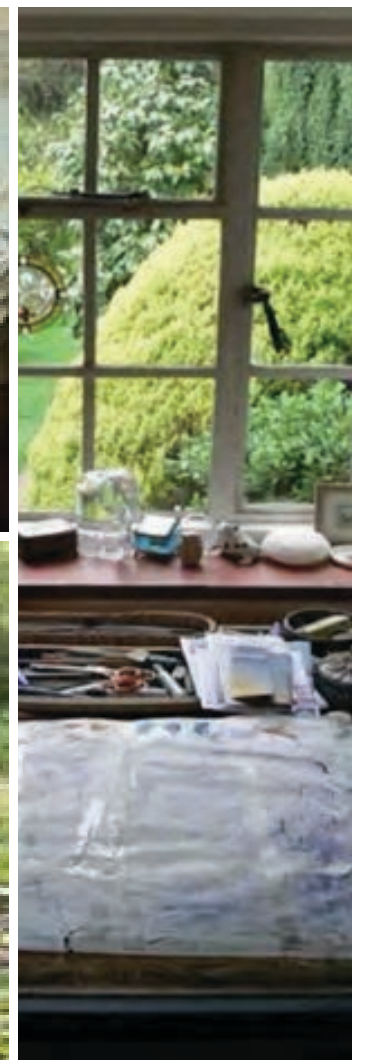
1



2



3



2014
SUIDONG Bay Eco Urban Design

SUIDONG BAY
ECO URBAN DESIGN
in Pearl River Delta
Waterfront Revitalization Studio

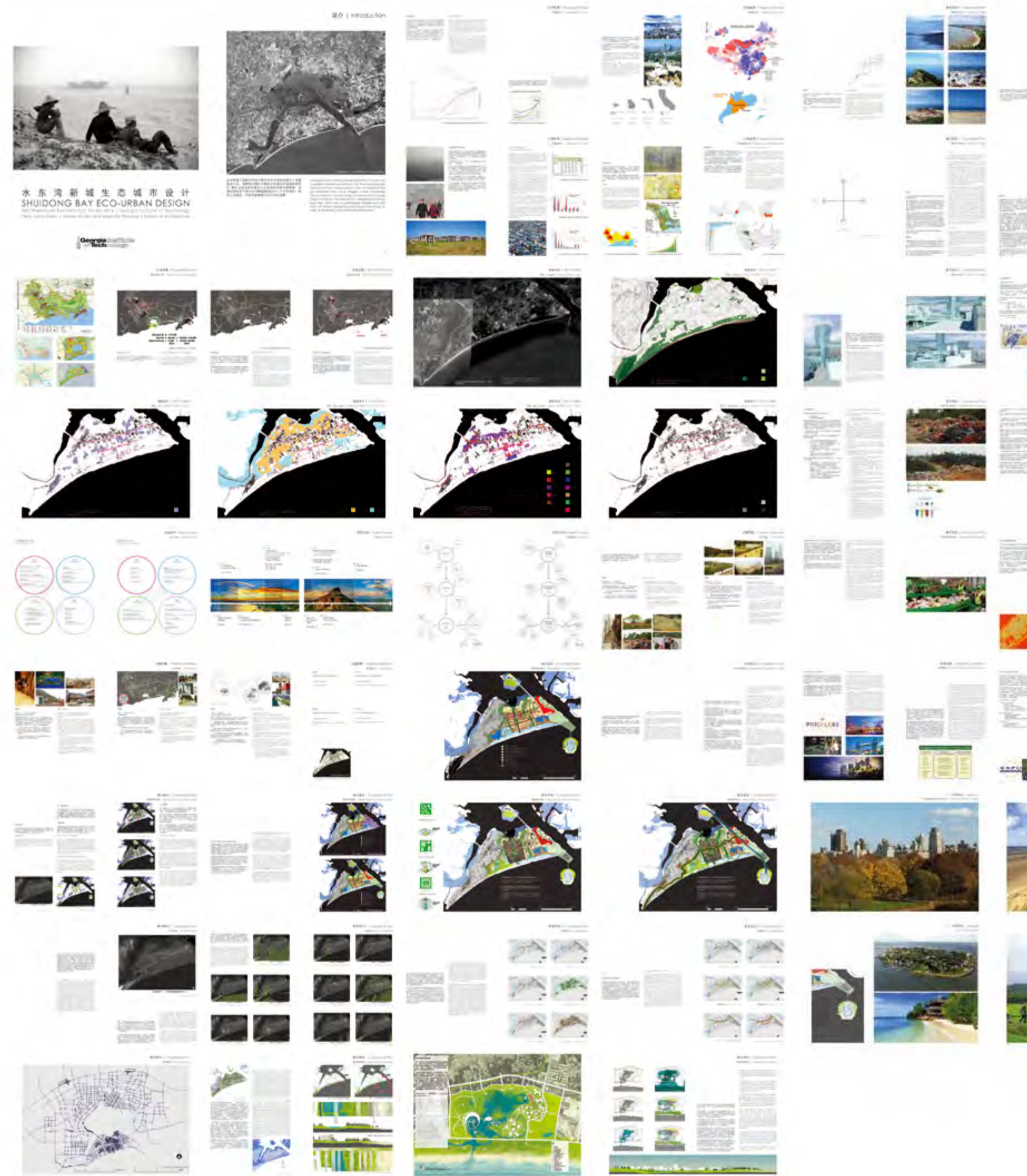
MCIF group: Damon Cooper, Chelsea Rogood, Alyssa Hutchinson, George Maier, Sean McTague, Ryan Sager, Christina Sloan, Audrey Spiegel, Logan Tsura
March group: James Park, Junying Shi, Arisa Zandi

Georgia Tech's International Waterfront Studio has created a development plan for the Shuidong Bay New Town that is responsive to the demands of the government and local villagers while balancing the economic and ecological needs of the larger ring-city region. This plan aims to develop Shuidong Bay New Town into a sustainable, livable eco-city that will attract residents of Old Town Maoming, as well as domestic and international tourists.

Shuidong Bay New Town is located on the Nanhai Peninsula, within the City of Maoming, an energy hub of southern China. Decades of petrochemical manufacturing and oil refining have left Old Town Maoming facing significant environmental and public health concerns, igniting protests and social unrest. The government of Maoming is hoping to develop the Shuidong Bay New Town into a sustainable, livable eco-city that will attract residents from the old town, as well as domestic and international tourists. Currently, the Nanhai Peninsula houses 36,000 residents, most of whom reside in local villages and sustain their households through a mix of agricultural activities, the fishing industry, small-scale manufacturing, and port activities related to the petrochemical industry. The peninsula is facing challenges balancing industrial development, the ecological needs of the greater bay area, and the tourism-focused vision it holds for the future.

SPRING 2014

While in China, the Georgia Tech students and professors presented ideas, based on prior research as well as information gathered from the site investigations made over the course of the prior week. The students presented plans to integrate the local villages into future eco-tourisms, advocating for incremental improvement of the infrastructure and renewable energy and water systems for the villages. Additionally, students proposed restoration strategies for the mangroves at the bayfront and the sand dunes at the beach to allow the ecological systems to return to their natural functions. Ideas were also proposed to expand the economy beyond the port and tourism industries toward economic activities that would allow the skill sets of the villagers to be leveraged by creating green jobs.



2012 Agrarian Urbanism Studio A Low Energy Urban Agriculture System at Wheat Street Garden in Atlanta

School of City and Regional Planning and School of Architecture
College of Architecture

A LOW ENERGY AGRICULTURE SYSTEM at Wheat Street Garden in Atlanta

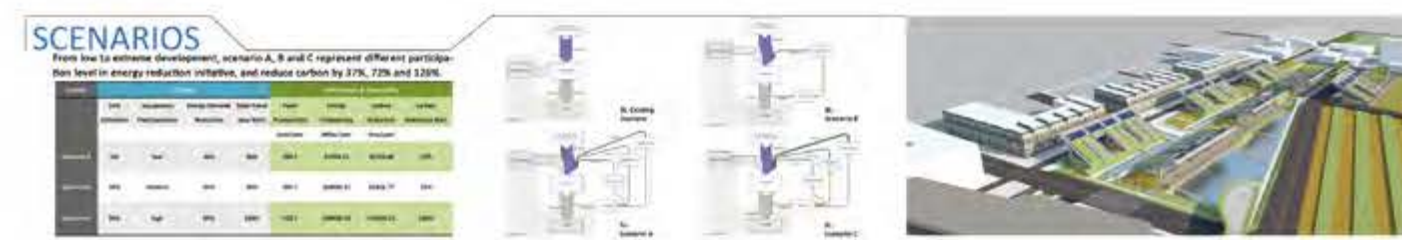
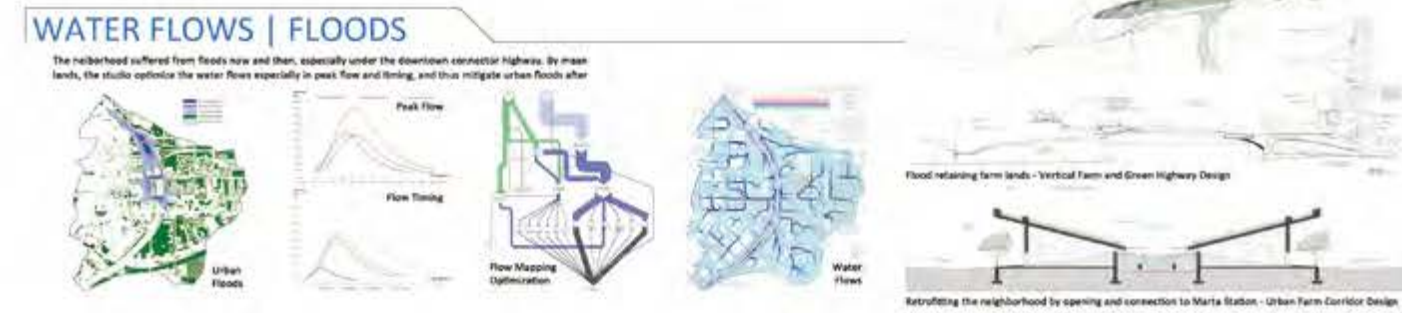
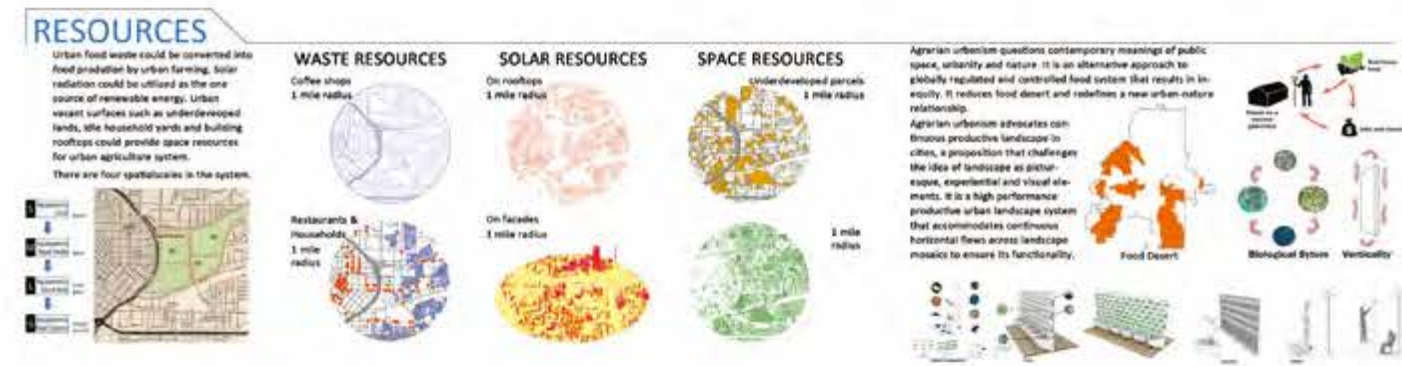
Agrarian Urbanism Studio

ICRF group: Capri Brone, Tasha Brooks, Travis Hampton, John Miller, Dung Nguyen
MARCH group: Patricia Andie, Dominique Baker, Jennifer Bull, Heidi Burroughs, Harshad Kankar, Evad Ebin, Jessica Pevck, Thomas Segars, Elizabeth Walsh

SPRING 2012

Ecological footprints of a city go far beyond its geographic boundary. The resources that cities rely upon today, including energy, materials, water and food are more connected to the "global hinterlands" rather than their adjacent local surroundings. The concept "food miles", how far the food travels, is not sufficient for understanding its ecological effects. The embodied energy and then its carbon emission that the food takes to produce, process, transport and distribute is far greater than we can imagine. The studio investigates agrarian urbanism, an emerging approach to reconstructing communities and cities ecologically, and its design and policy framework for reorganizing neighborhood and urban spaces by embedded sustainable food and agricultural system grounded on locality.

Agrarian urbanism explores how flows generate forms, a counter proposition to the modernist idea of form follows function. We argue that contemporary urban forms and landscape patterns should emerge from sustainable approaches to designing flows of energy, materials, water and food.



Strategic Planning for Kaohsiung's Free Economic Zone and New Asian Bay Area 2013



Strategic Planning for Kaohsiung's Free Economic Zone (FEZ) and New Asian Bay Area

A Report of Waterfront Revitalization Studio 2013

Sponsor: Kaohsiung City Government

Planning Team: School of City and Regional Planning, College of Architecture, Georgia Institute of Technology May, 2013

2012 siteplanning CP8823PY/ ARCH8823 Site Planning and Urban Ecosystems Simulation

SITE PLANNING AND URBAN SIMULATION Haralson+San Francisco+Atlanta+New York+Chicago Perry Yang Studios

Fall 2012, Carson Minsky, Zi Sun, Chung Hsueh, Hong Yu, Yunfei Kang, Kai Luo, Natalie Quilley, Kambhampati Anuj, Siddharth Jethi, Ting-Ting Chen
Fall 2013, Hanyang Dai, Peter Samson, Javi Garcia de la Cruz, Tobias Hopp

2012 + 2013

Site planning has been seen as one of basic professional skills for city planners, urban designers and architects. There is a strong intellectual legacy from the works of Kevin Lynch, Donald Appleyard, Carl Steinitz and Gary Hack who defined site planning as "an art of arranging structure on the land and shaping the spaces between" (Lynch and Hack, 1983), a system approach to planning urban and natural settings over a defined spatial and temporal environment in context.

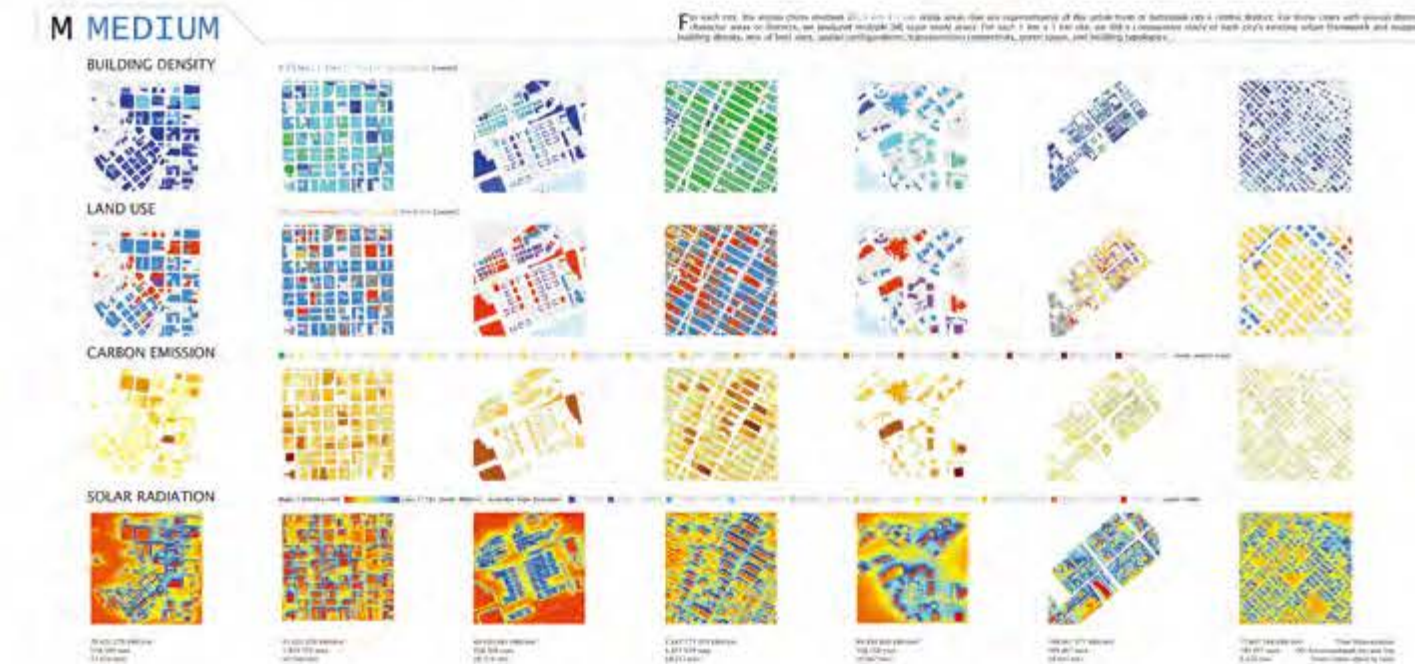
The course introduces literature in site planning and the foundation of skill development through a series of workshops. It provides visual-based analytical techniques and related simulation tools based on dimensions of representation, analysis and design. The synthesis of the three constitutes a method for engaging site and urban ecological systems across scales from building lots, neighborhoods, cities to regional spaces.

The course also aims for extending the knowledge and skill set of site planning to new challenges of post-oil city by integrating emerging technologies and performance-based design tools for mapping ecological flows in cities including energy, carbon, material, water, human movement and informational flows across territories and spatial scales over time. The representation, analysis and design of sites and urban ecological systems are to be driven by questions behind the shaping of high performance, renewable and resilient urban environment, focusing on urban ecology, renewable energy, carbon offset strategies and the making of sustainable site and urban systems.



Ecological Urbanism Studio: GLOBAL BENCHMARKING for LOW CARBON URBAN DESIGN

Perry Yang Studio, Spring 2011
 School of City and Regional Planning + School of Architecture
 College of Architecture



GLOBAL BENCHMARKING for Low Carbon Urban Design

Ecological Urbanism Studio

ICRF group: Mikal Abdullah, Rafi Akash, Michael Cutler, Anna Day, Yanhui "Lisa" Douangchai, Jemma Lee, Allen Looff, Robert Plattowall, Patrick Sewell, Michael Warren
 March group: Arpan Figue, Chandri Anand, Chris Park, Eric Batlogg, Ken Kuo, Nathaniel Willey, Rajah Raymond, Sara Heesack, Timothy Wheelock

The project was produced by the ecological urbanism studio, a performance-based urban design studio conducted in Spring of 2011 for both School of City and Regional Planning and School of Architecture at the Georgia Institute of Technology. It is a model of studio teaching that connects urban design and energy-related carbon and solar analyses. Seven global cities and their central urban districts were chosen for mapping the urban physical structure, energy-carbon footprints and solar availability. Design strategies for carbon reduction were then tested by proposing alternative scenarios of density and ecological urban block design.

Based on selected downtown or midtown urban settings from North American and East Asian cities, including Atlanta, Chicago, Macau, Manhattan, Shanghai, Tokyo and Vancouver, the analyses involve the mapping of density, diversity, urban block structure as well as the performance measures of urban visibility, solar availability and energy-related carbon footprints from large (L), medium (M) to small (S) scales.

We aim to derive a set of principles of low carbon urban design through the mapping of global urban settings to benchmark their performance measure and criteria. The global cities benchmarking provides a basis for proposing a hypothetical framework of designing a new ecologically sensitive urban district. In the case of Chicago Loop, we propose a future urban block design that would reduce 69.2% carbon of the existing operation based on those low carbon design principles by reconfiguring the current block structure to have better energy-carbon efficiency and greater solar availability over the solar-powered urban surface and building envelop. Each hypothetical proposal includes both design and its corresponding performance measure based on L, M and S levels of spatial analyses and visualization techniques.

The ecological urbanism studio addresses a broader question on how ecological analysis can be taken as organizational principles for making architectural and urban form. It is essential to engage design through performance-based analysis of geometrical and material attributes of urban environment. We argue that the future low energy-carbon urban form should emerge from performance-based urban design.

8 Benchmarking Carbon and Energy Performance of Cities and Districts - China, Asian and Global Cities



7 Benchmarking Energy Performance of Urban Districts in Shanghai and other cities



6 Research on Shanghai 2040 Urban Future



5 Benchmarking Carbon Emissions of Asian and Global Cities



4 Renewable Energy Cultivation in Cities



3 From Facebook to Spacebook



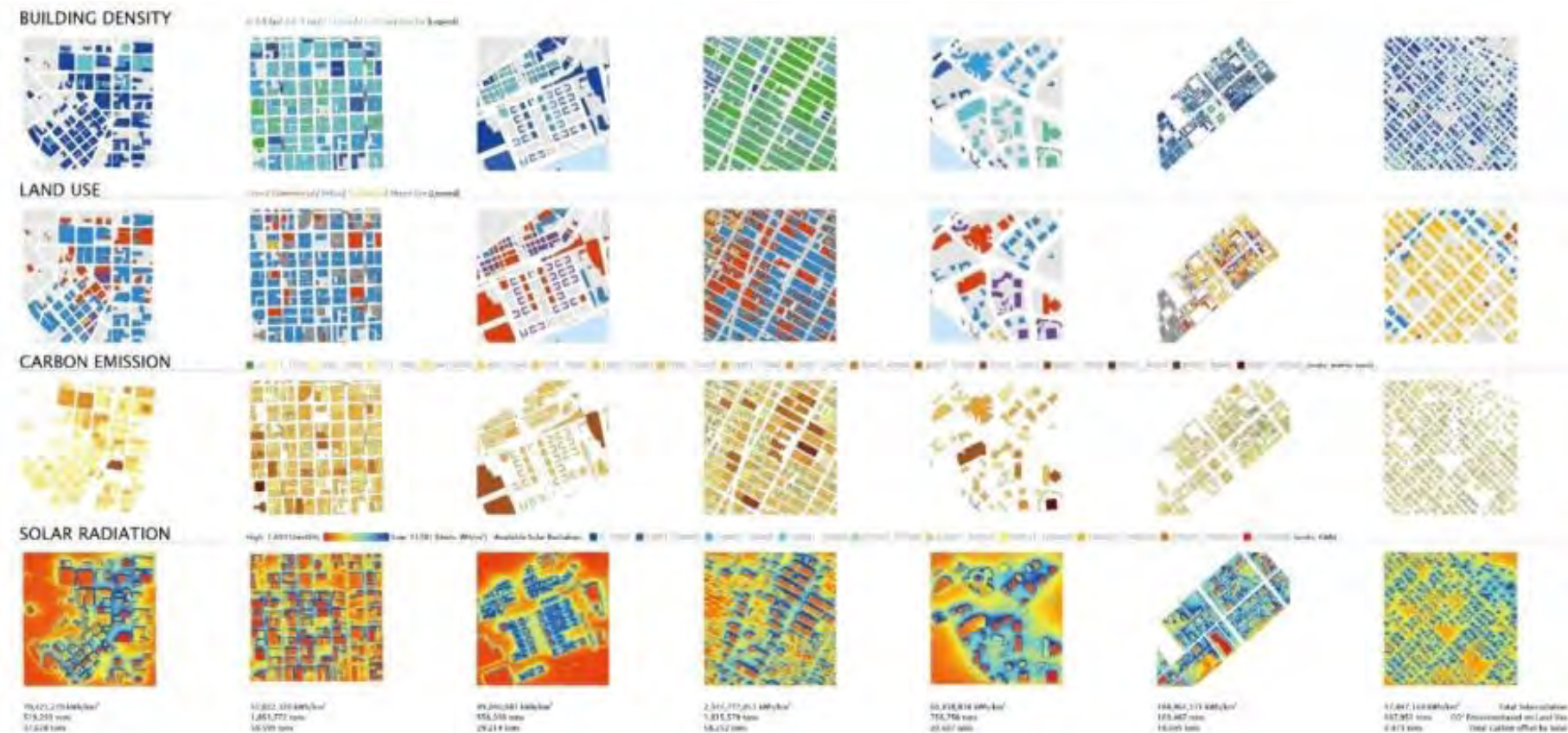
2 Healthy City: Promoting Health-in-design



1 Big data and mappings of user behavioral patterns in cities



Benchmarking Carbon and Energy Performance of Cities and Districts - China, Asian and Global Cities



District	Building Density (m²/ha)	Land Use (%)	Carbon Emission (tCO₂e/ha)	Solar Radiation (kWh/m²/yr)	Population (1000)	CO₂ Intensity (tCO₂e/ha)	Population Density (1000/ha)	CO₂ Intensity per Person (tCO₂e/person)
District 1	10000	60% Residential, 40% Commercial	10000	10000	1000	10000	1000	10000
District 2	5000	50% Residential, 50% Commercial	5000	5000	500	5000	500	5000
District 3	1000	80% Residential, 20% Commercial	1000	1000	100	1000	100	1000
District 4	10000	70% Residential, 30% Commercial	10000	10000	1000	10000	1000	10000
District 5	5000	60% Residential, 40% Commercial	5000	5000	500	5000	500	5000
District 6	1000	90% Residential, 10% Commercial	1000	1000	100	1000	100	1000
District 7	10000	50% Residential, 50% Commercial	10000	10000	1000	10000	1000	10000

Benchmarking Energy Performance of Urban Districts in Shanghai and other cities



Research on Shanghai 2040 Urban Future



Benchmarking Carbon Emissions of Asian and Global Cities

in collaboration with Global Carbon Project (GCP), Tsukuba, Japan

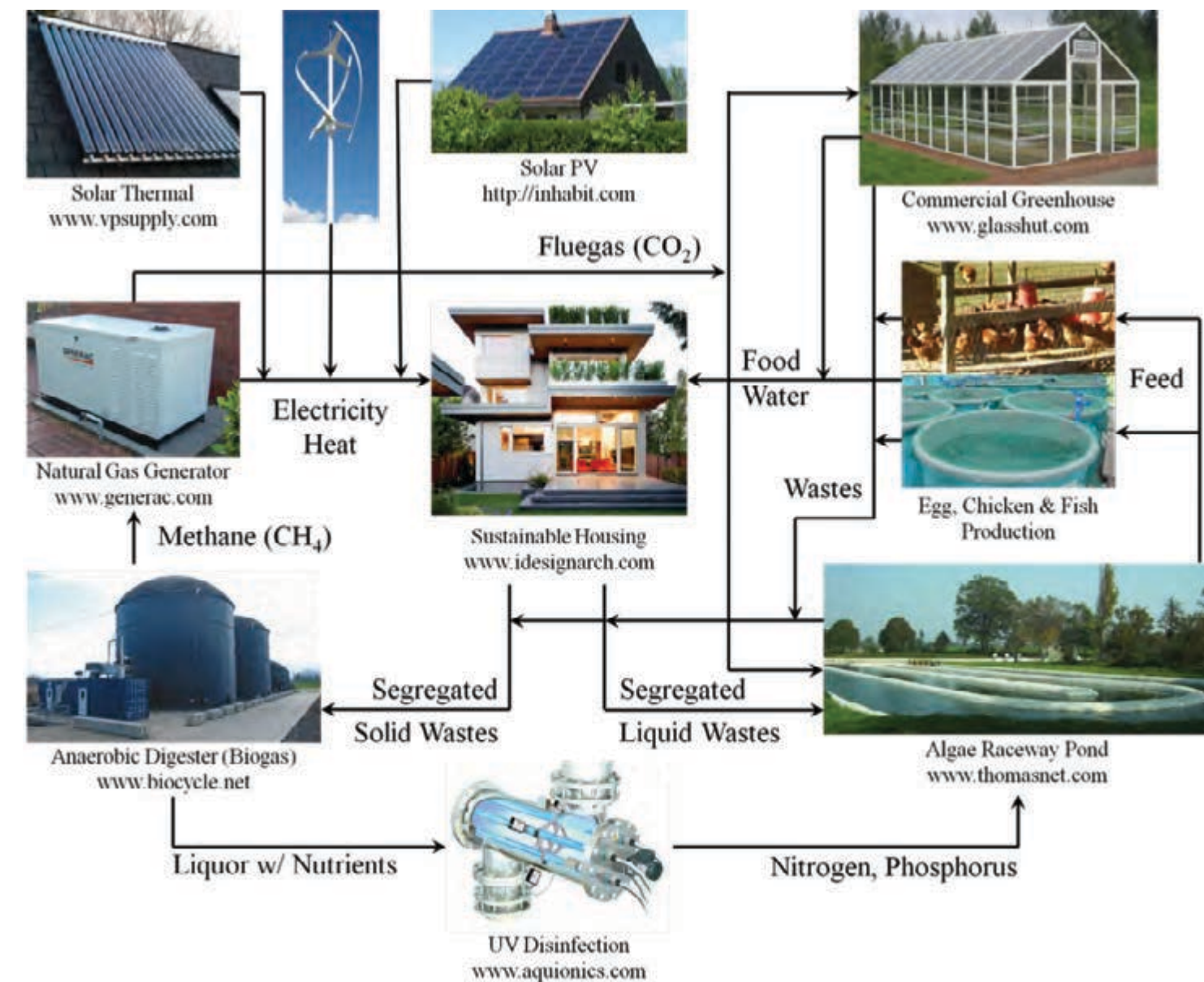
The Global Carbon Project (GCP) is one of the joint projects of the Future Earth initiative which will develop the knowledge for responding effectively to the risks and opportunities of global environmental change and for supporting transformation towards global sustainability in the coming decades. The goal of GCP is to develop a comprehensive, policy-relevant understanding of the global carbon cycle, encompassing natural and human dimensions and their interactions.



Renewable Energy Cultivation in Cities



Sustainable Housing through Holistic Waste Stream Management and Algal Cultivation
 \$1,644,957, funded by National Science Foundation,
 Daniel Castro, Perry Yang and Charles Rudolph (Georgia Institute of Technology), in collaboration with Ohio University, 2012 – 2016
 Left: Algae cultivation system module, Chen, School of Civil and Environmental Engineering, Georgia Institute of Technology

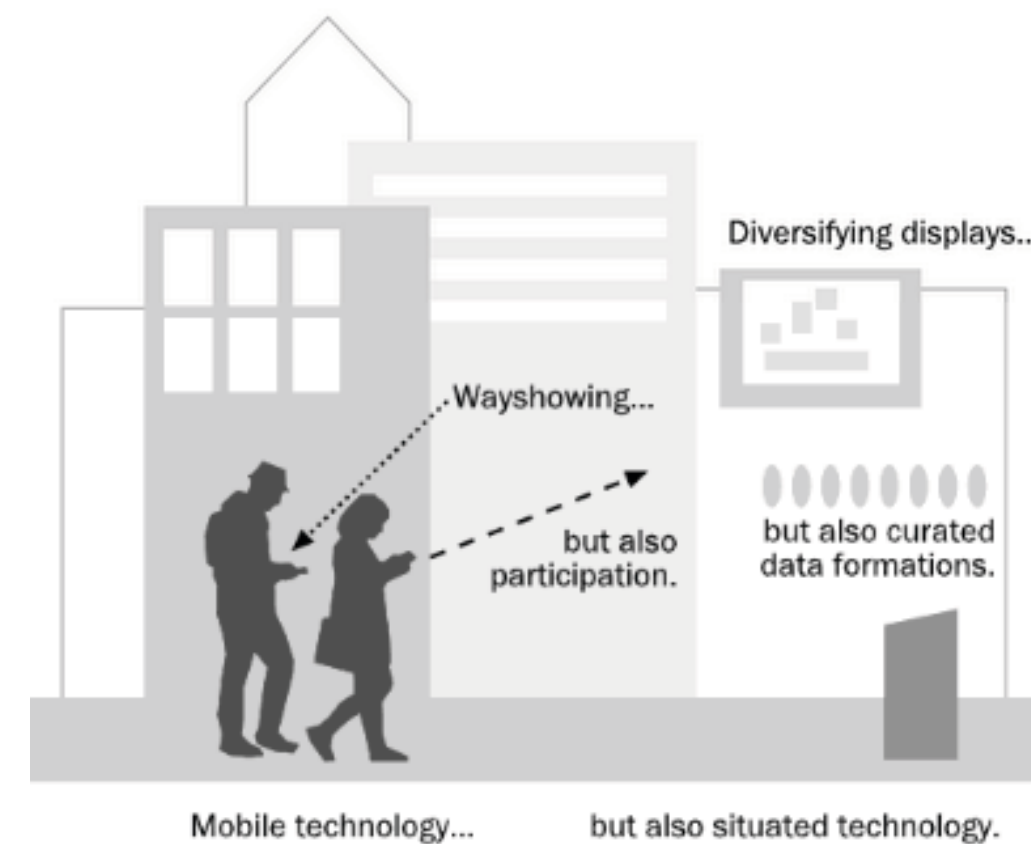


The devices used in the algae-powered house system

Smart City Place Making From Facebook to Spacebook



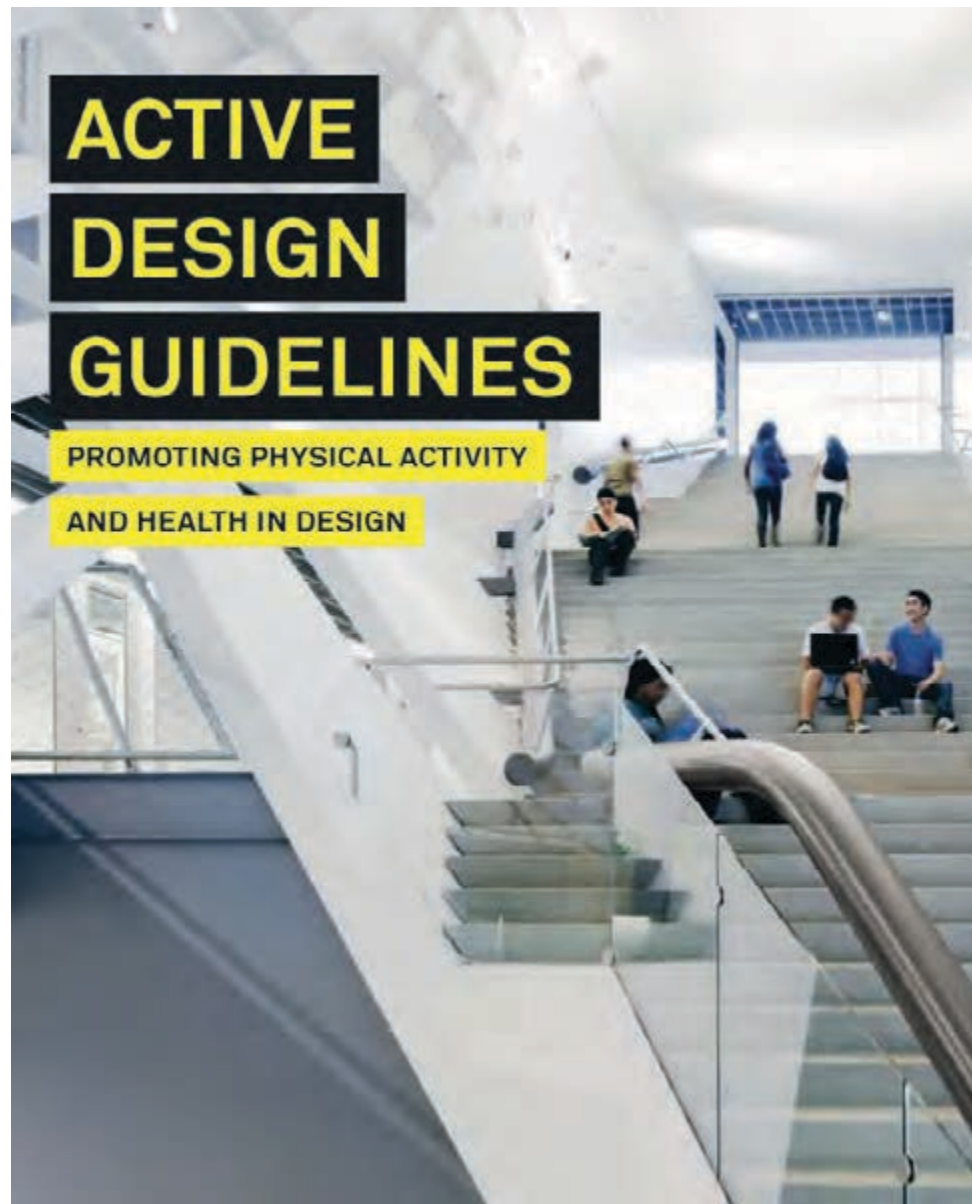
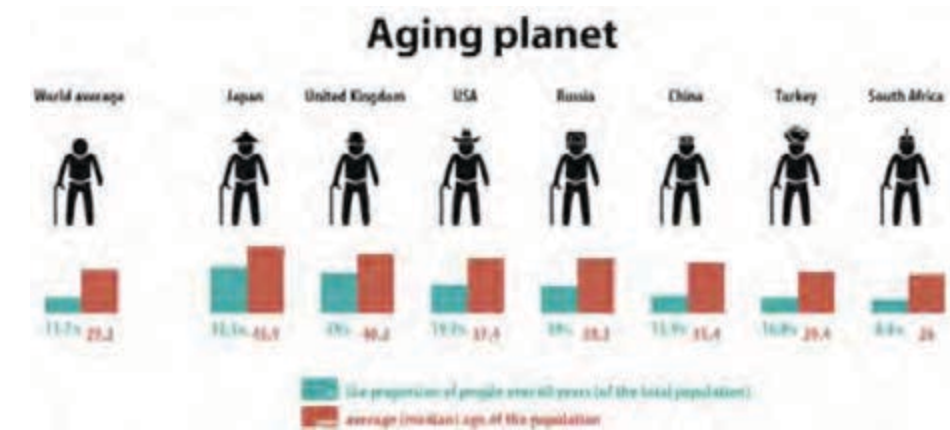
iBeacon
<http://en.wikipedia.org/wiki/iBeacon>



How does the users' behavioral patterns adapt to the change of ambient environment for increasing resiliency, recyclability and sustainability?

Can we use pervasive computing and sensing technology to get people in tune with their surroundings?

Healthy City: Promoting Health-in-design



Big data and mappings of user behavioral patterns in cities

Temporal analysis of tweets tracks one's daily life. An imagined day of a whitecollar in San Francisco, described by her/his tweets.



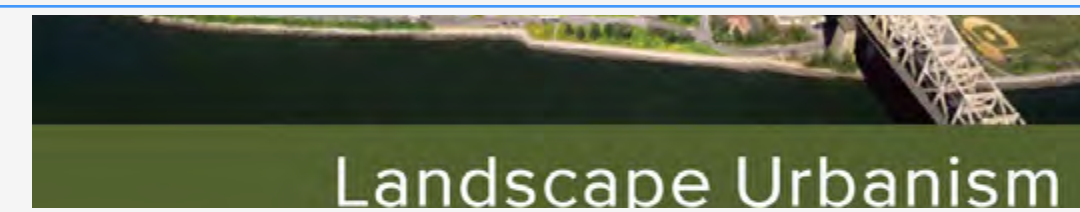
5 'Urban Data and Building Energy Modeling: A GIS-Based Urban Building Energy Modeling System Using the Urban-EPC Engine' in Planning Support Systems and Smart Cities



4 'Energy resilient urban planning' in Geodesign by Integrating design and geospatial sciences



3 'Landscape ecology and its urbanism' in Landscape Urbanism and its Discontents: Dissimulating the Sustainable City



2 Ecological Urbanism
Scale, Flow and Design



1 SELECTED PAPERS

Urban Data and Building Energy Modeling: A GIS-Based Urban Building Energy Modeling System Using the Urban-EPC Engine

Quan, Steven J., Li Q., Augenbroe, G., Brown, J., Yang, Perry P. J.* (2015), Urban Data and Building Energy Modeling: A GIS-Based Urban Building Energy Modeling System Using the Urban-EPC Engine, in Planning Support Systems and Smart Cities, Geertman S. et al. (eds.), Springer.

Lecture Notes
in Geoinformation and Cartography

LNG&C

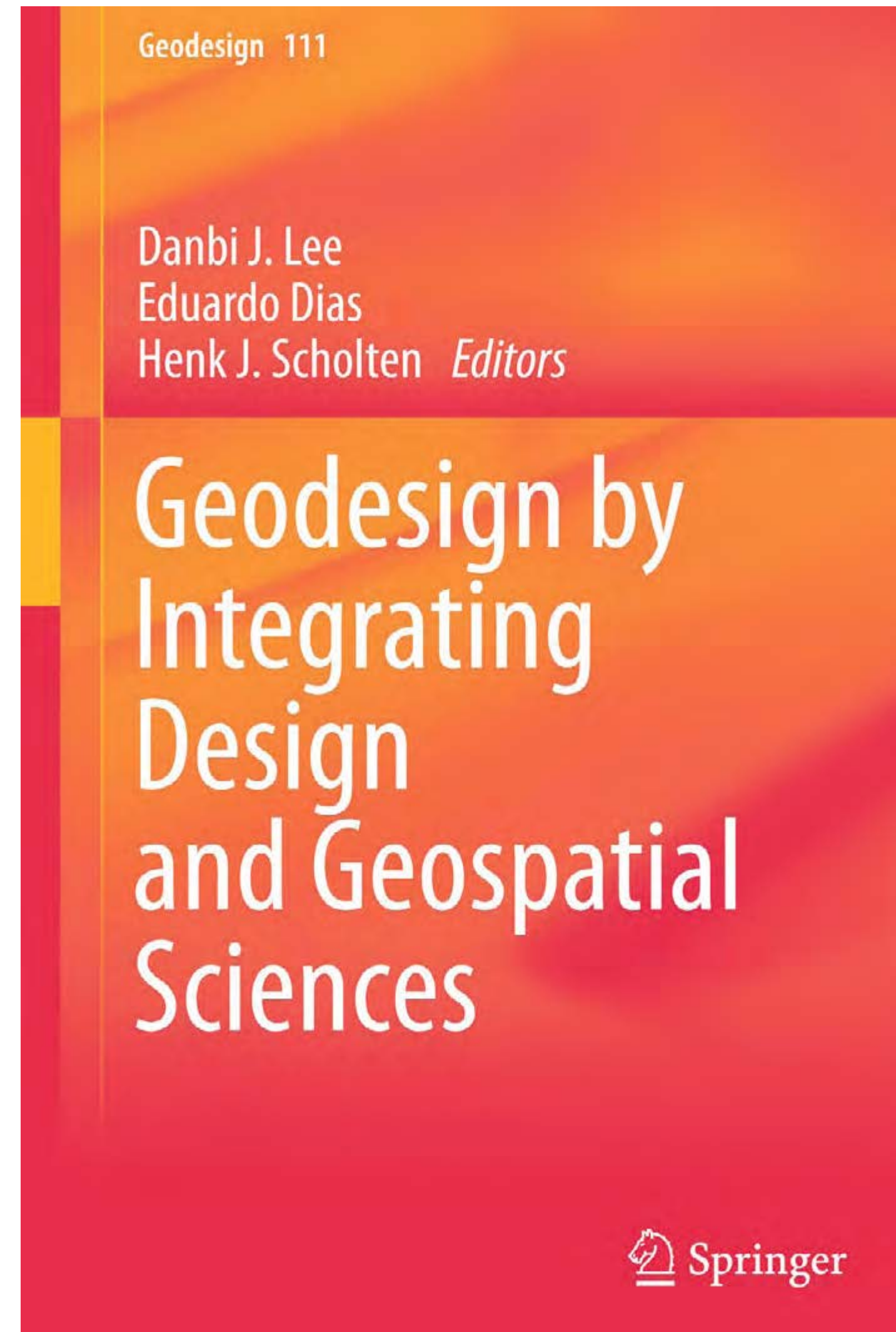
Stan Geertman
Joseph Ferreira, Jr.
Robert Goodspeed
John Stillwell *Editors*

Planning Support Systems and Smart Cities

 Springer

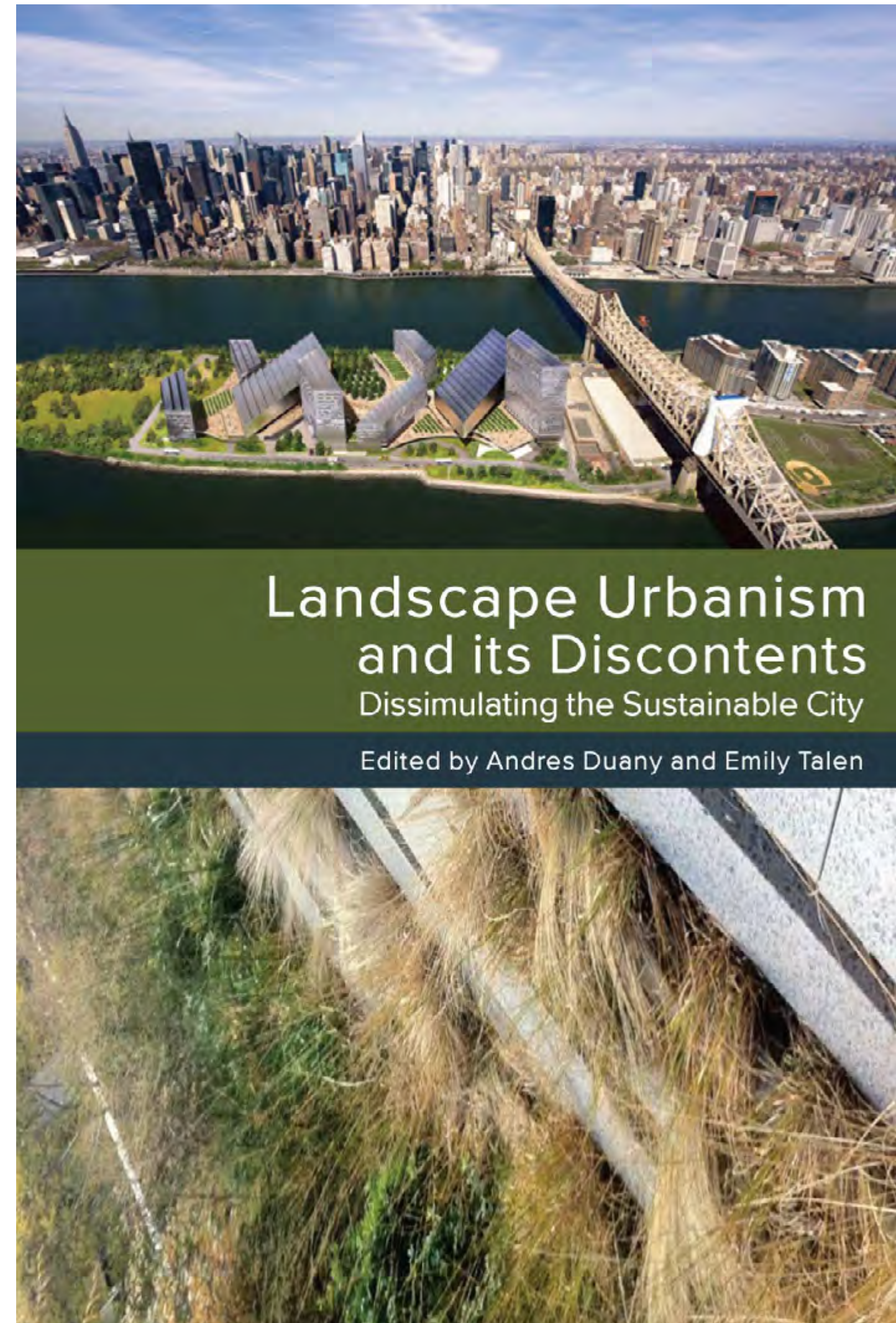
Energy resilient urban planning

Yang, Perry P. J. (2014) “Energy resilient urban planning” , in Geodesign by Integrating design and geospatial sciences, Lee D and Dias E, Scholten H eds., Springer.



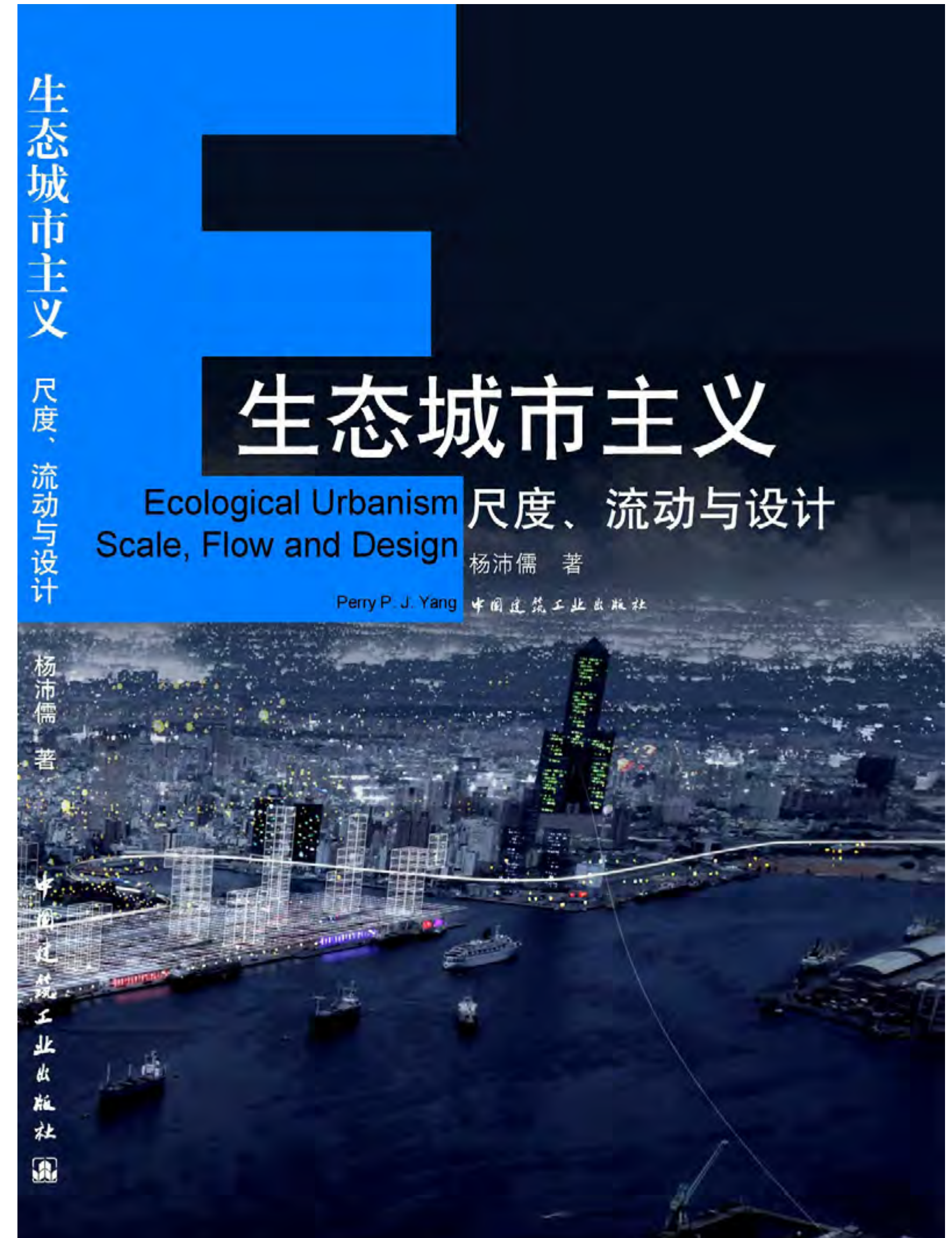
Landscape ecology and its urbanism

Yang, Perry P. J. (2013) “Landscape ecology and its urbanism” in Landscape Urbanism and its Discontents: Dissimulating the Sustainable City. Andres Duany and Emily Talen eds., Island Press.



Ecological Urbanism Scale, Flow and Design

Yang, P P J, (2010) Ecological Urbanism: Scale, Flow and Design, China Architecture and Building Press.



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- 9 Yang, Perry P. J. (2013) "Hydrological effects of urban form and landscape change", in Planning stormwater resilient urban open spaces, vol. 3, F.D. Moccia and M.F. Palestino eds. Clean, Napoli.
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- 8 Quan, S. J., Minter, J., Yang, Perry P. J. (2013) "A GIS-based performance metrics for designing a low energy urban agriculture system" in Planning Support Systems for Sustainable Urban Development, Springer Publication. (as the corresponding author)
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- 7 Yang, Perry P. J. (2012) Complexity Question in Urban Systems Design, in Journal of Architectural Engineering Technology, editorial, Vol. 1, Issue 2.
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- 6 Yang, P P J, (2010) Ecological Urbanism: Scale, Flow and Design, China Architecture and Building Press.
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- 5 Yang, P P J, (2009) Questioning urban sustainability: social sufficiency, ecological efficiency and ecosystems compatibility. Journal of Urbanism, November 2009, Vol. 2, Issue 3.
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- 4 Yang, P P J, (2008) Tracking Sustainable Urban Forms and Material Flows in Singapore. In World Cities and Urban Form: Fragmented, Polycentric, Sustainable? Jenks M, Kozak D. and Takkanon P eds., Routledge.
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- 2 Yang, Perry P. J., Putra S. Y., Chaerani M. (2007) Computing the Sense of Time in Urban Physical Environment, Urban Design International. 12.
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- 1 Yang, P P J, Ong B L, (2004) Applying ecosystem concepts to the planning of industrial areas: a case study of Singapore's Jurong Island. Journal of Cleaner Production, 12, 8-10
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5 Eco Urban Lab: Eco Urban Design



4 Applied Energy Innovation Institute: Future Energy Systems



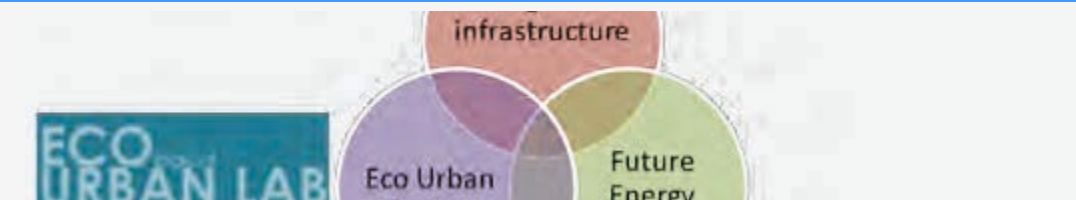
3 Disney Research China: Integrated infrastructure



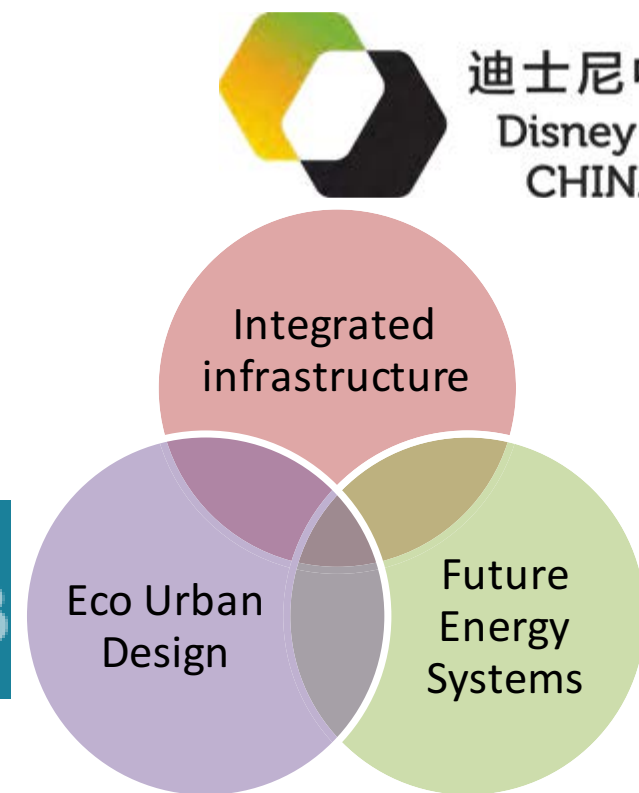
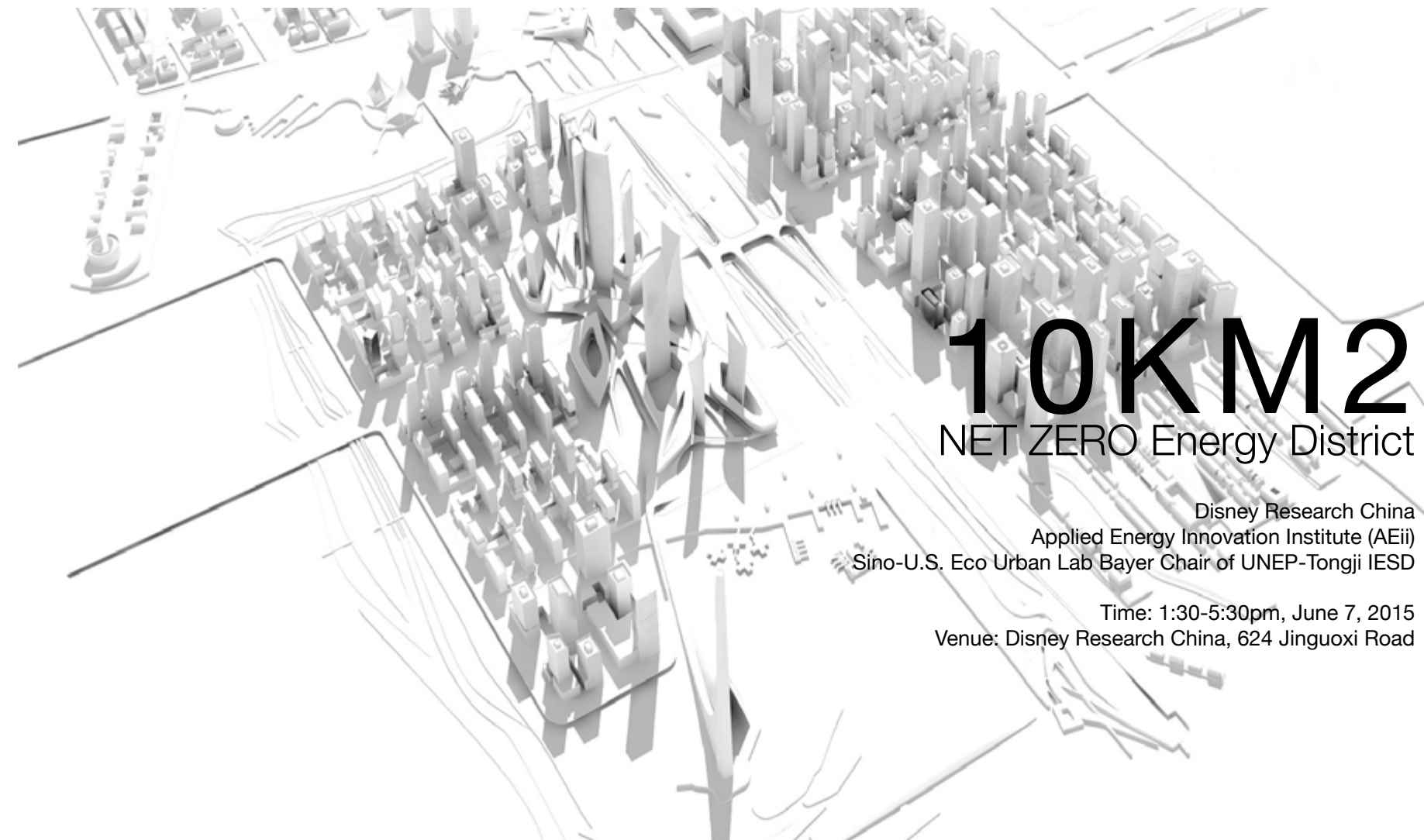
2 10KM2 NET ZERO Energy District : PROCESSES



1 10KM2 NET ZERO Energy District



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