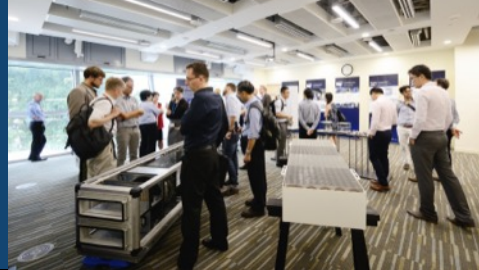


3for2 Beyond Efficiency:

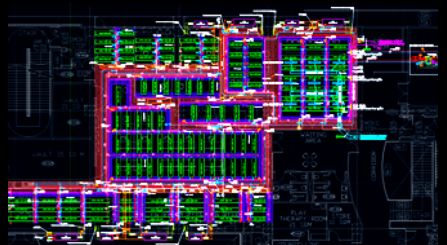
Towards the most-energy efficient office in Singapore

Dr. Adam Rysanek, Senior Researcher, 3for2 Project Manager



CREATE
Centre for Research Excellence And Technological Enterprise

ETH Zürich



Who we are

Architecture and Building Systems Group Institute of Technology in Architecture, ETH Zürich

- Research group based in Zurich and Singapore
- Currently 22 PhD, post-Docs, researchers
- Interdisciplinary: engineers, architects, computer scientists, physicists,
- Our objective: To research and develop technologies for future sustainable buildings in the tropics that significantly use less energy and material

School of Architecture and Andlinger Center of Energy and the Environment, Princeton University

- Ass. Prof. Dr. Forrest Meggers and his team
- Academic partner



Arno Schlueter



Forrest Meggers



Adam Rysanek



Yuzhen Peng



Esmail Saber



Marcel Brülisauer



Jovan Pantelic



Kian Wee Chen



Matthias Mast



Portia Murrar

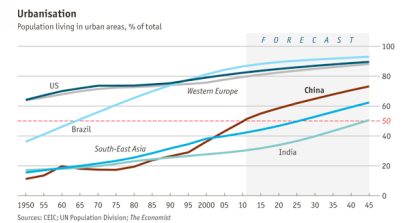
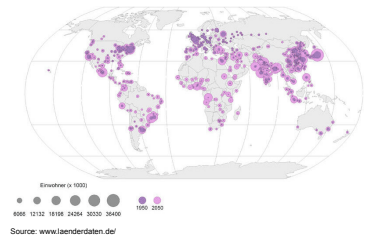


Clayton Miller

Context Singapore

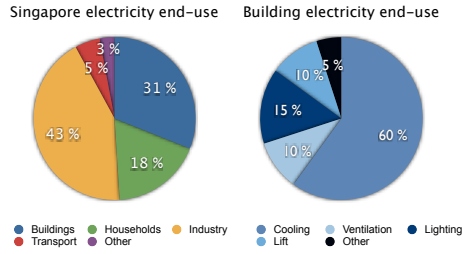
Urbanization

- India and S.E. Asia expected to see a near two-fold increase in urban population over the next 30 years



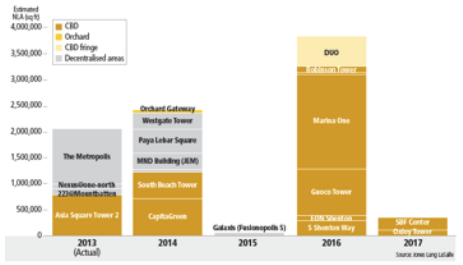
Energy and Cooling

- Buildings consume ~50% of Singapore's total electricity production, of which 70% is used for air conditioning



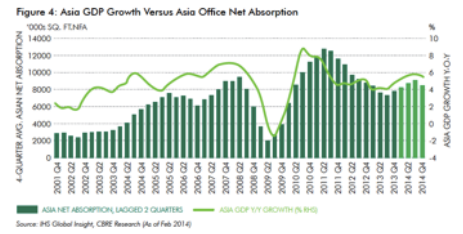
Building Development

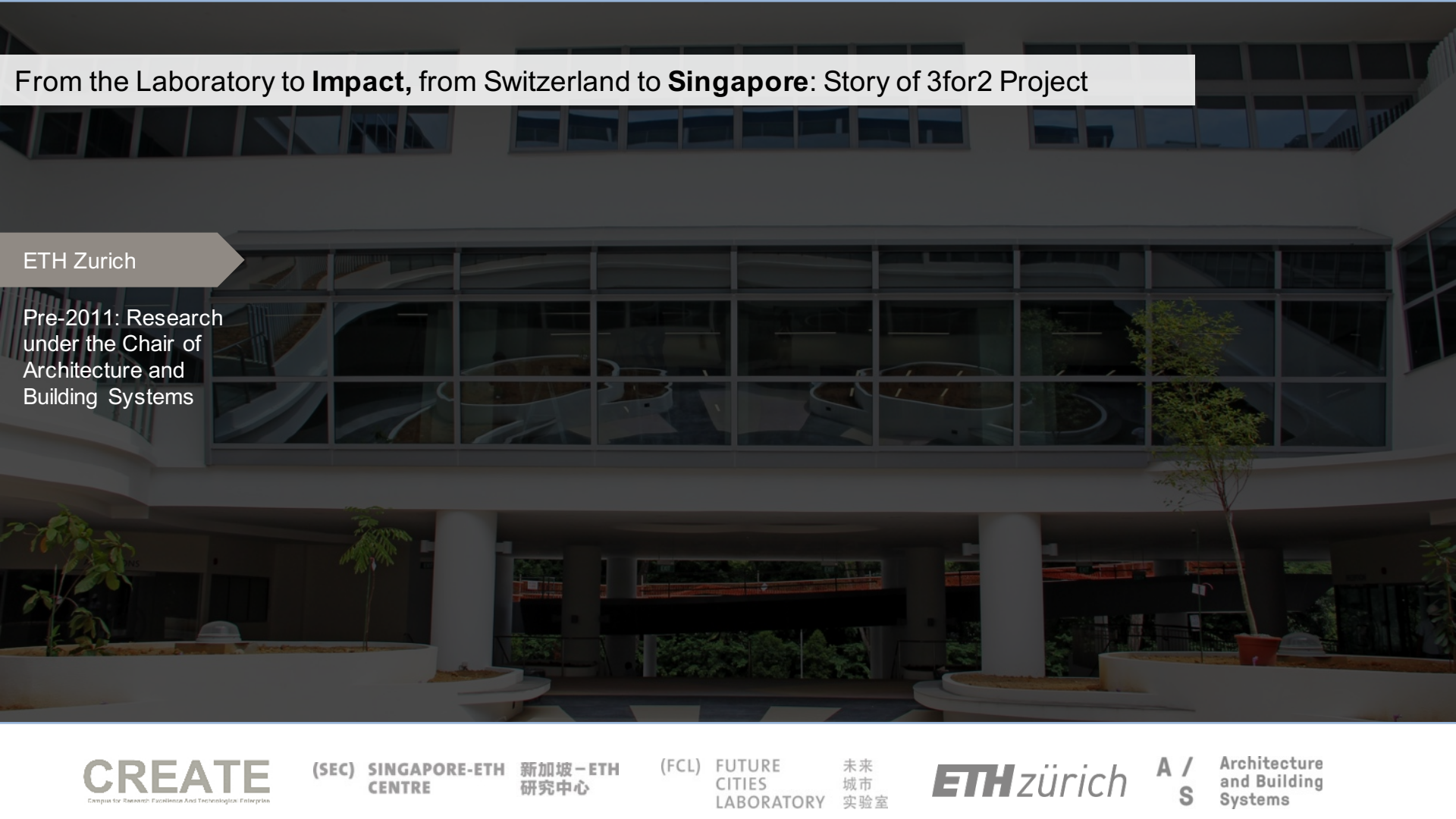
- Growth of Singapore's non-domestic building stock still booming, though much of it on reclaimed land



GDP and Office Space

- Coupling of GDP growth and service sector growth in both Singapore and across Asia Pacific





From the Laboratory to **Impact**, from Switzerland to **Singapore**: Story of 3for2 Project

ETH Zurich

Pre-2011: Research
under the Chair of
Architecture and
Building Systems

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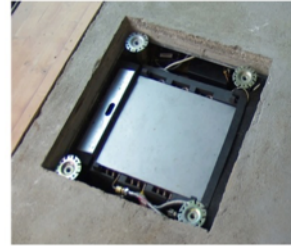
ETH Zurich



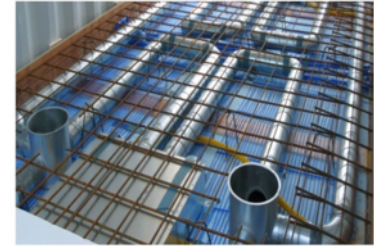
The BubbleZERO Laboratory

Future Cities Lab I:
Low Exergy
Research Module

2011-2014: Four years of
research on new approaches to
energy-efficient air-conditioning
for the tropics



Integrated distributed ventilation units



Slab integrated ventilation ducts

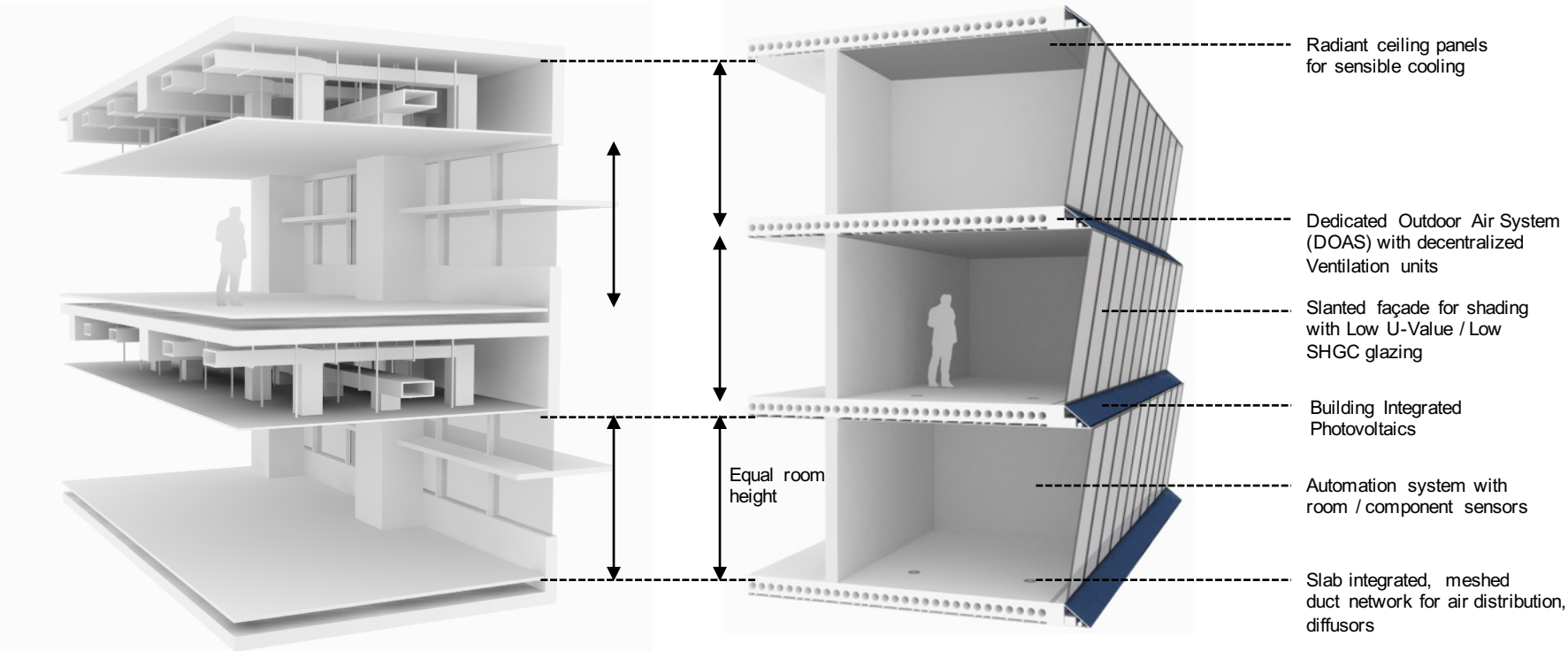


Interior view of the laboratory



Radiant cooling panels

3for2 – a new Paradigm for Energy Efficient Offices in the Tropics



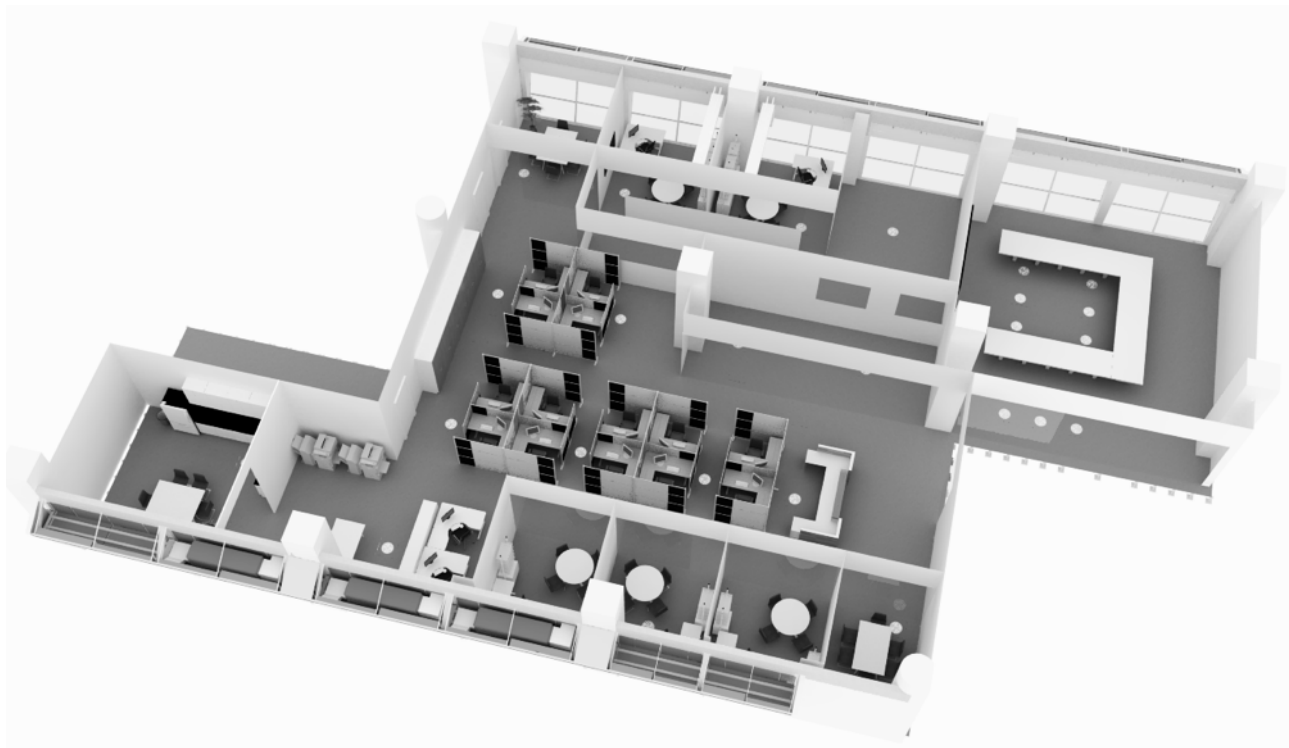
Conventional Design

3for2 Design

3for2: Beyond Efficiency – Pilot at the United World College of South East Asia (UWCSEA)

- The world's largest international school (~5,000 pupils), split over two academic campuses
- UWCSEA Tampines Campus (built 2011) is becoming known as one of the most energy-efficient operating facilities in the region
- New 20,000 sq m. block constructed at Dover campus over 2014-2015
- FCL was invited to contribute the '3for2' concept to a 600 sq.m area





From the Laboratory to **Impact**, from Switzerland to **Singapore**: Story of the 3for2@UWCSEA Project

Siemens Building Technologies

United World College S.E. Asia

3for2@UWCSEA (2014-2018):

The first pilot implementation of the 3for2 concept in Singapore

ETH Zurich

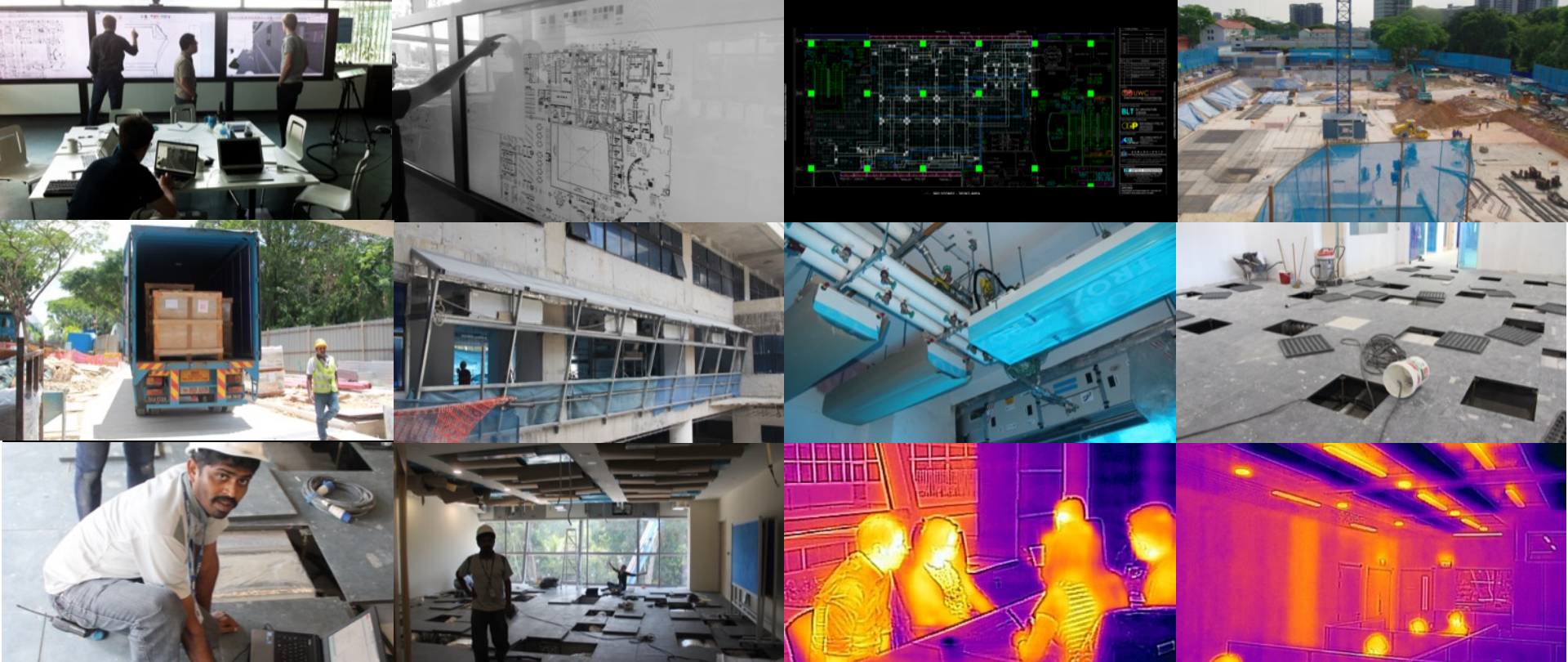
National Research Foundation (NRF)

Future Cities Lab I (2011-2015):
Low Exergy Research Module

Future Cities Lab II (2015-2019):
Multi-scale Energy Systems



BCA Green Building Innovation Cluster (GBIC)



Designing, Constructing, and Commissioning 3for2@UWCSEA (2014-2015)



3for2@UWCSEA (2015)

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CENTRE 新加坡-ETH
研究中心

(FCL) FUTURE
CITIES
LABORATORY 未来
城市
实验室

ETH zürich

A /
S Architecture
and Building
Systems



3for2@UWCSEA (2016)



3for2@UWCSEA Grand Opening: January 19, 2016

From the Laboratory to **Impact**, from Switzerland to **Singapore**: Story of 3for2 Project

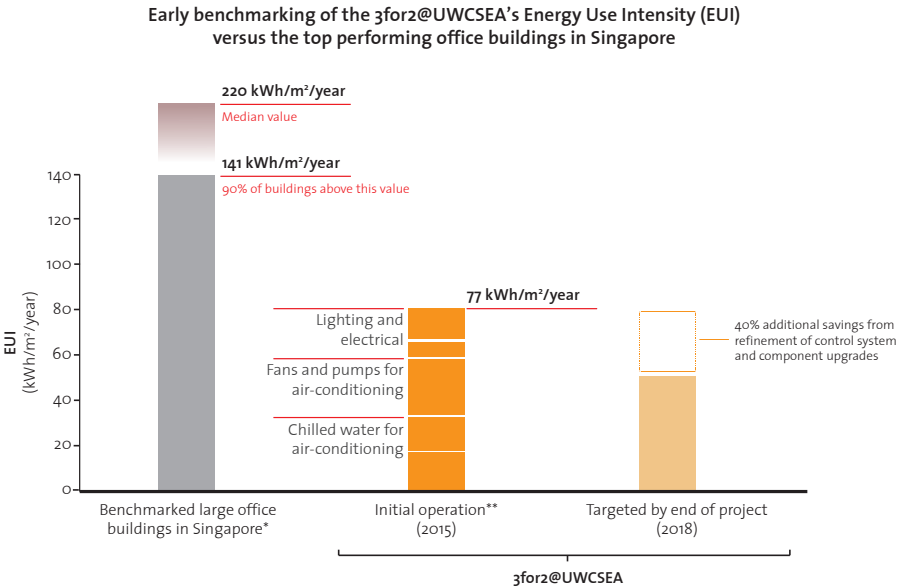
- ETH Zurich
- NRF & BCA
- Siemens Building Technologies
- United World College S.E. Asia

3for2@UWCSEA:
The first pilot
implementation of the
3for2 concept

Demonstration of homegrown innovation

- One of the most energy-efficient office spaces in Singapore since day 1 of operation
- A first-of-its-kind for Asia: a web-connected building automation system
- Planned to host the country's most energy-efficient chiller by 2018

From the Laboratory to **Impact**, from Switzerland to **Singapore**: Story of 3for2 Project

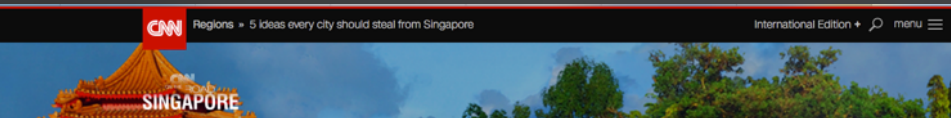


* Data from BCA Building Energy Benchmarking Report 2015 (<http://www.bca.gov.sg/sustain/sustain.html>)
** Aggregation of 18 days of operational data from December 2015 - assumes 252 days of system operation per year

Demonstration of homegrown innovation

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From the Laboratory to **Impact**, from Switzerland to **Singapore**: Story of 3for2 Project



5 ideas every city should steal from Singapore

By Meera Senthilingam, for CNN



7 photos:

Singapore's climate is hot and humid resulting in large amounts of electricity -- and space -- consumed by air cooling units and dehumidifiers. The Future Cities Laboratory is piloting a project in which air external to a building is dehumidified and used to cool the façade of a building through units integrated into its walls.

Demonstration of homegrown innovation

Outreach and influence

Over 300 visitors since launch of the project in 2014 including:

- Deputy CEO of BCA (Industry Development) Mr. Lam Siew Wah and management of BCA Research Division
- Senior Management from Capital Land, Keppel Land, Lend Lease, Ascendas
- Senior faculty from NUS, NTU, and SIT

Media coverage in Singapore and abroad, including:

- CNN (Global), The Straits Times, Business Times, TODAY, ChannelNewsAsia, Lianhe Zaobao, Eco Business, (Singapore), Business Weekly, Baublatt (Germany), Le Temps (Switzerland), Sourceable (Australia), Blue&Green Tomorrow (UK)

The 3for2 story thus far: Research. Development. Capacity Building.

CORE RESEARCH ORGANIZATIONS

ETH zürich

CREATE
Centre for Research Excellence And Technological Enterprise

(SEC) SINGAPORE-ETH CENTRE 新加坡-ETH 研究中心

(FCL) FUTURE CITIES LABORATORY 未来城市 实验室

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Turner & Townsend