

THE FCL SIMULATION PLATFORM

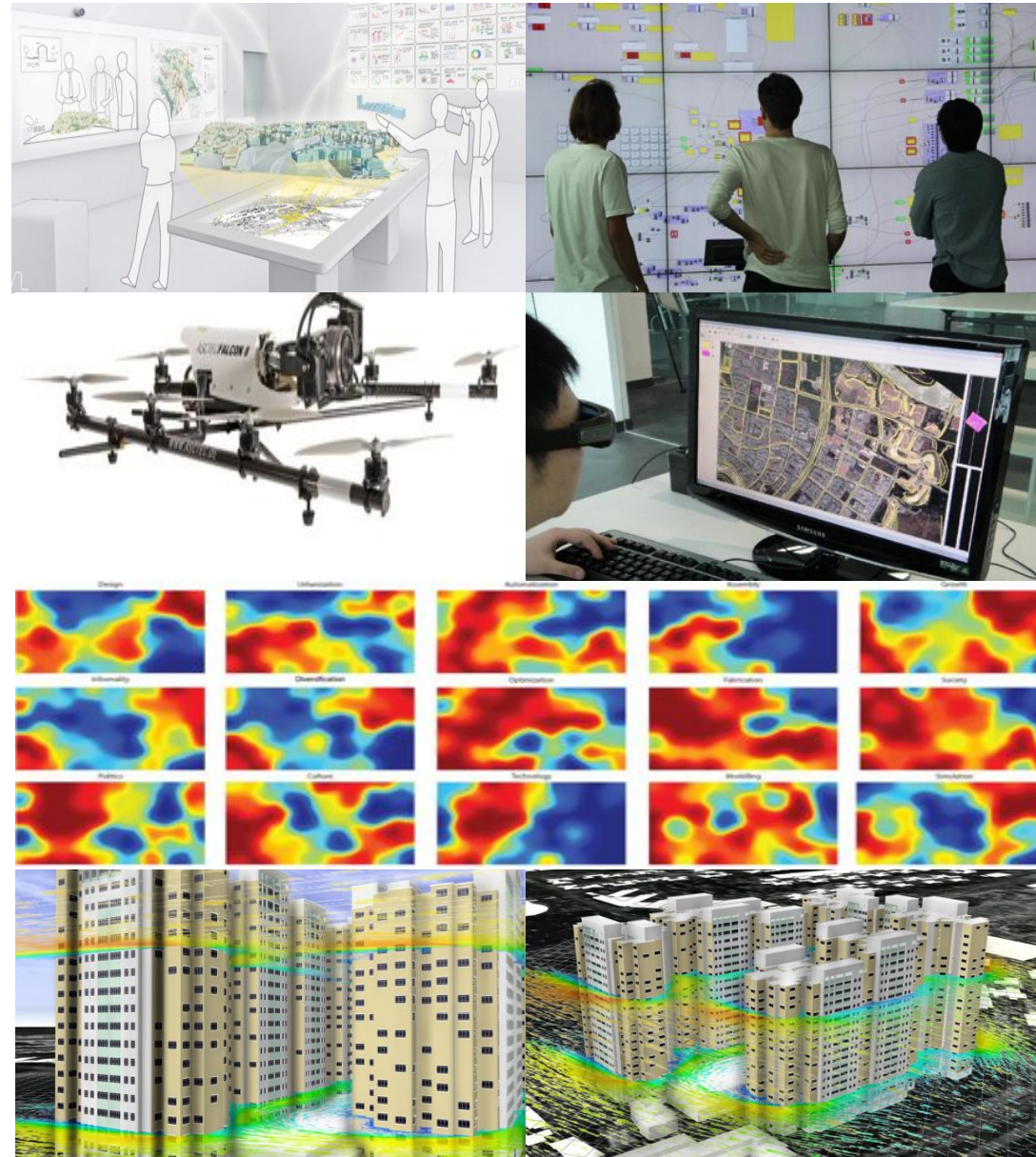
Overarching Goal: Find new methods for better understanding ever growing amounts of urban data. Make this knowledge available to decision makers, urban planners and stakeholders.

Research Achievements

- Completion of Value Lab Asia in March 2012.
- Singapore's first UAV flights for data acquisition (NUS campus).
- Novel use of self-organizing maps for urban data.
- Combination of CFD wind flow analysis and generative modelling.
- Numerous scientific publications, including one book.

Service Contributions

- Established IT service infrastructure.
- Contributed to NRF CREATE IT infrastructure planning.



Building Model – Little India





Assistant Professorships

Assistant Professorship of
Architecture and Construction

Asst. Prof. Dirk Hebel

Investigating various scenarios
pertaining to the question of waste in
the making of the globalising city.

Image source: Dirk Hebel

Back to
Stocks & Flows

Earth - SUDU



Soil - SRDU



Core Empirical
sing

Straw - SECU



Waste – ICE ADDIS





Assistant Professorships

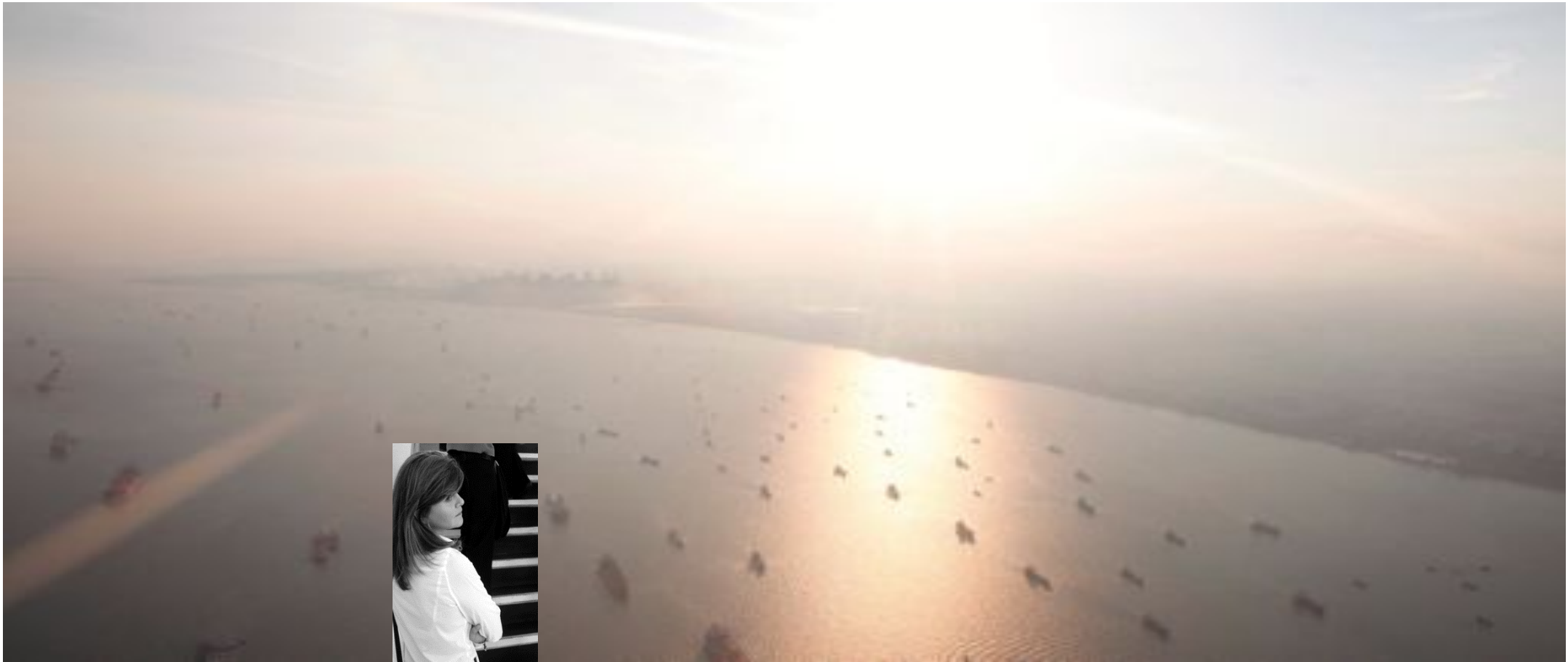
Assistant Professorship of
Architecture and Urban Design

Asst. Prof. Alex Lehnerer

Research in the field of steering the
city by means of regulatory
frameworks.

Image source: Alex Lehnerer

Back to
Stocks & Flows



Assistant Professorships

Assistant Professorship of
Architecture and Territorial
Planning

Asst. Prof. Milica Topalovic

Researching on Singapore's
hinterlands in the region Singapore-
Johor-Riau and their functional links
with the city.

Image source: Milica Topalovic

[Back to
Stocks & Flows](#)

Scales, Stocks and Flows

SPACE
ENERGY
MATERIALS
PEOPLE
CAPITAL
WATER
INFORMATION

SMALL

BUILDING TECHNOLOGY

LOW EXERGY

DIGITAL FABRICATION

A/P ARCHITECTURE & CONSTRUCTION



**342x project: 3 floors for the space of 2,
at 2x the efficiency**

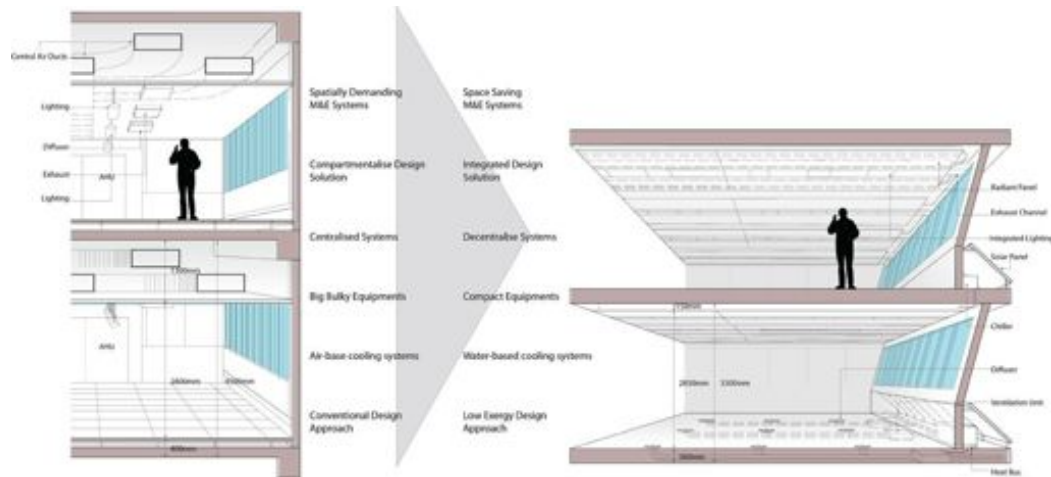


Developing systems to cut the electricity used for the standard air-conditioner and to reduce CO2 emissions caused by air conditioners.



Back to 3 scales

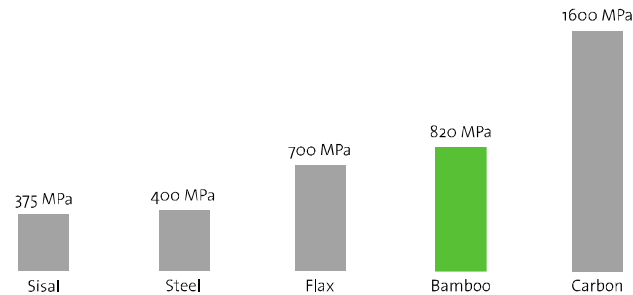
“3 for 2x”



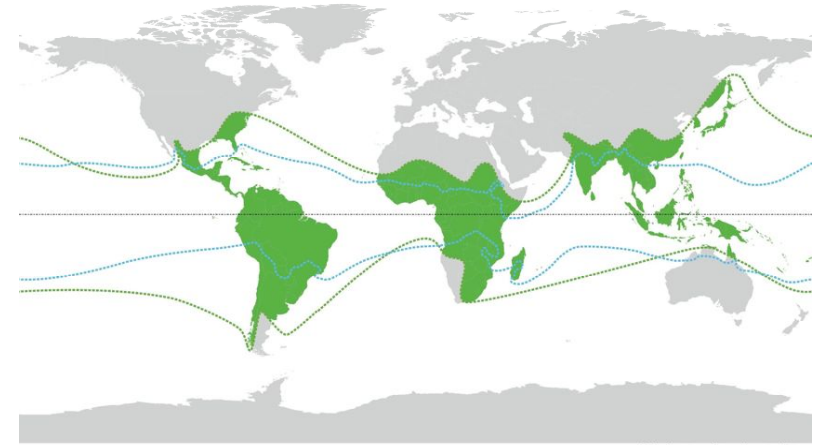
3 for 2x – proposal in progress

- Application of Low Exergy technologies and integrated design in a real building project
- Reduce space consumption by 33%
- Improve standard energy efficiency and comfort by 2x
- Possible Industry Partners: Siemens, Cobiax for biaxial void construction, BS2 Switzerland Arch App for ventilation system, Uponor for radiant cooling system, etc.

Bamboo Concrete



Strength (MPa)
Comparison with other fibres
from composite materials group (2012)



Global Natural Bamboo Habitat

National Geographic (1980)

Research question: Can bamboo fibers be used to replace steel as a reinforcement material in concrete?

SMART Innovation Grant awarded in March 2013

Benefits of Bamboo as a construction material:

- Grows in most developing countries
- Tensile strength is double that of construction steel
- Produced as a composite material, it could be used as reinforcement in concrete structures
- It is a renewable resource, cheap, light and strong



Scales, Stocks and Flows

SPACE
ENERGY
MATERIALS
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INFORMATION

MEDIUM URBAN DESIGN

TRANSFORMING & MINING URBAN STOCKS

HOUSING

URBAN DESIGN STRATEGIES & RESOURCES

URBAN SOCIOLOGY

A/P ARCHITECTURE & URBAN PLANNING



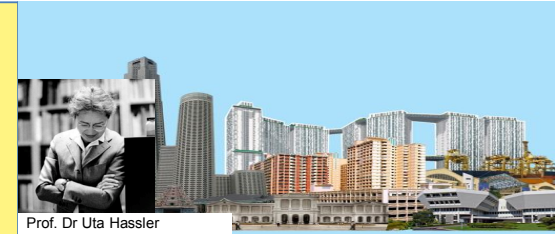
Asst. Prof. Alexander Lehnerer

Research in the field of steering the city by means of regulatory frameworks.



Prof. Dr Christian Schmid

Comparative studies of cities.



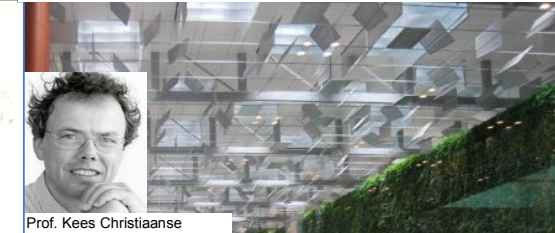
Prof. Dr Uta Hassler

Exploring the preservation and conservation of heritage buildings.



Prof. Sascha Menz

An Interdisciplinary Case Study on the Development of Singapore Public Housing Typologies (1960-Present).



Prof. Kees Christiaanse

Investigating the notion of centralities in the city, and the role of the airport with respect to mobility, migration and infrastructure.

Back to 3 scales

Kampung+

This project aims to apply incremental urban development approaches to slums in Batam and Jakarta, including appropriate energy generation, waste management technologies and habitat types.



Regional plan study combining the urban settlement plan with hinterlands of horticultural strips and industrial zone on the coast of Batam.

Partners:

ETH

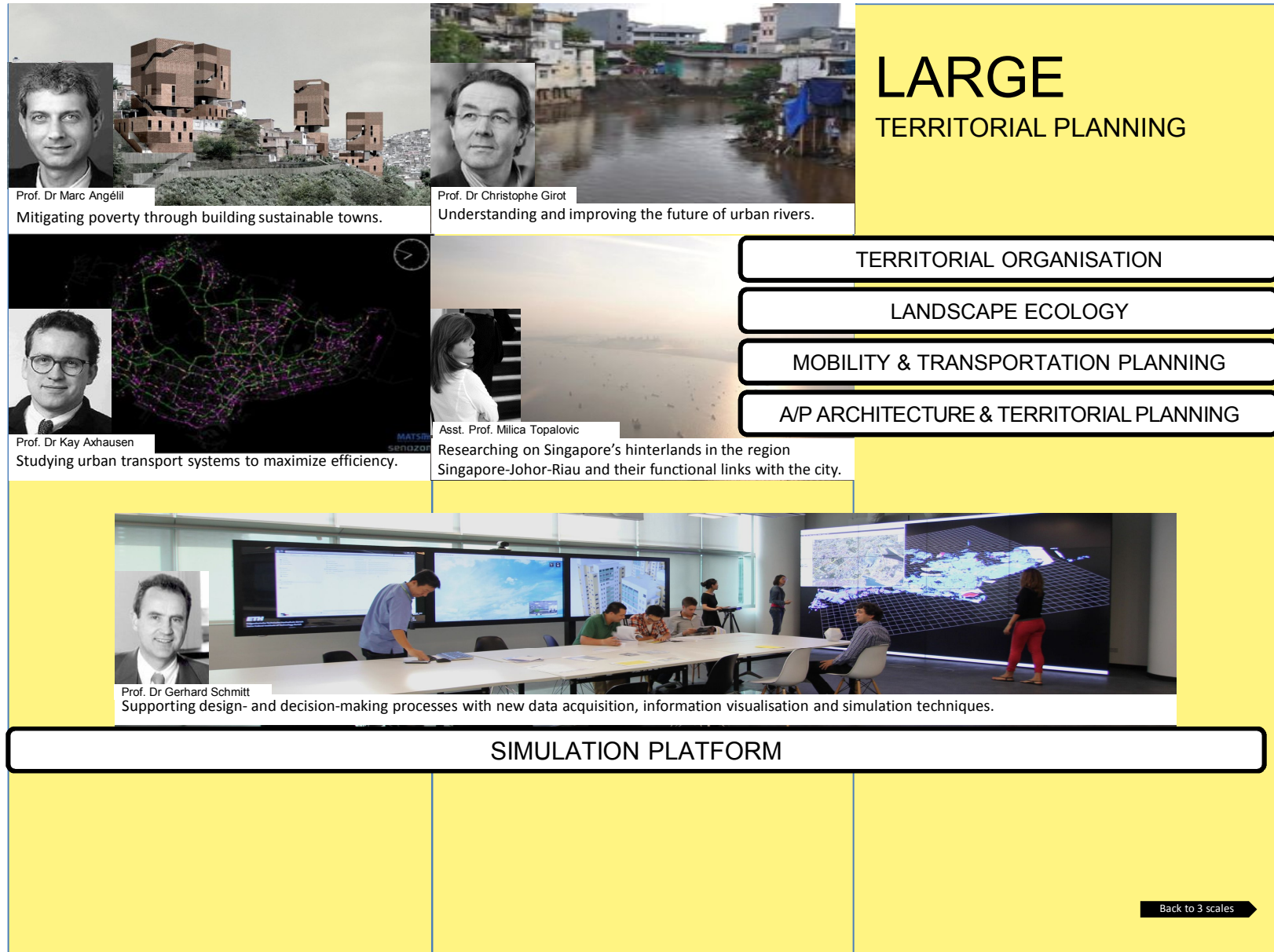
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich



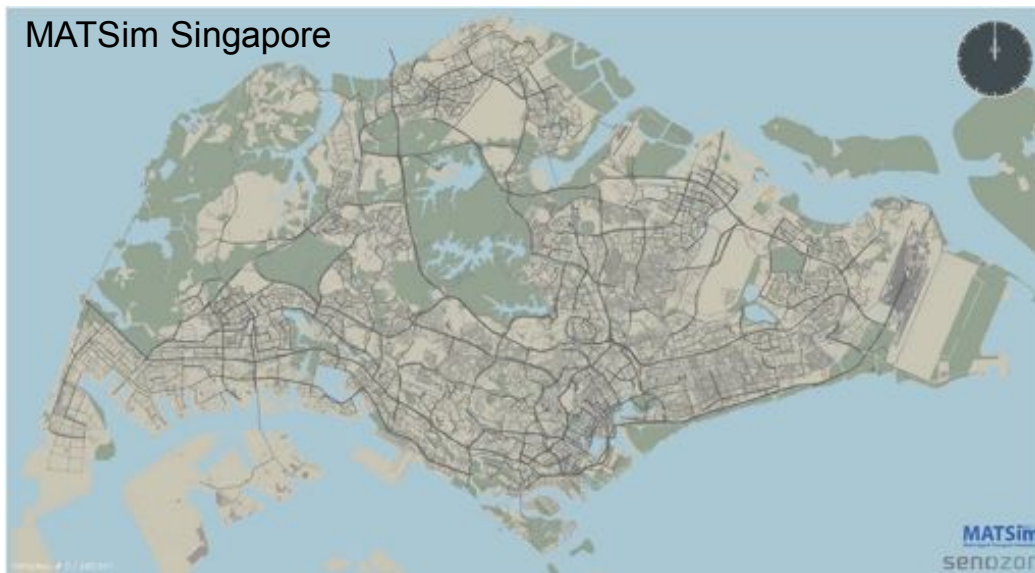
Municipal governments in Batam and Jakarta

Scales, Stocks and Flows

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MATSPaaS – Multi-Agent Transport Simulation Platform as a Service



MATSPaaS – SMART Innovation Grant proposal submitted Aug 2013

- To develop MATSim Singapore into a commercial service
- Make large-scale, agent-based transport models and simulations accessible via a cloud-based, client server simulation platform
- Potential clients: urban planners, transport planners and industry (e.g. real estate developers)
- Proposal received support by Ministry of Transport and LTA

Singapore Partnerships

SEC Sep 2010:
Established with 2 people

SEC TODAY: 137 staff, 31 nationalities

- 10 Principal Investigators
- [15 Affiliated Faculty \(NUS, NTU\)](#)
- 3 Assistant Professors

- 27 Senior Researchers / Post-Docs
- 45 PhD candidates
- 43 Masters students
- [Awards](#)
- [Synergy Projects](#)



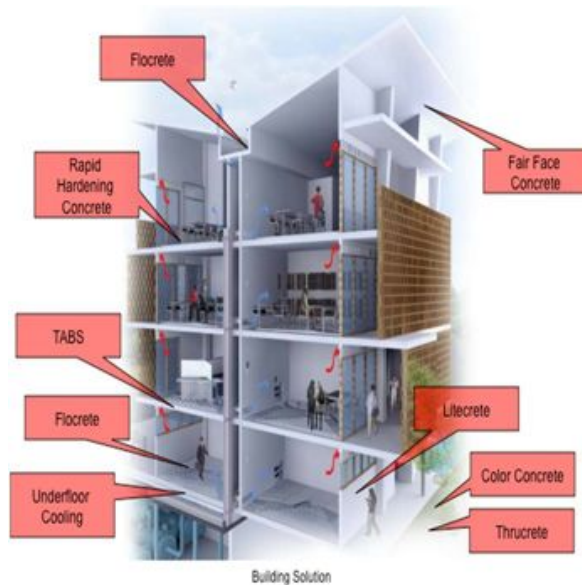
Partnerships with Industry – Case Study



Consultancy on Siemens City Lifecycle Management Tool

- 1 year project
- Led by 1 FCL Principal Investigator and PhD students
- City Modeling and Simulation
- FCL team: Simulation Platform Module

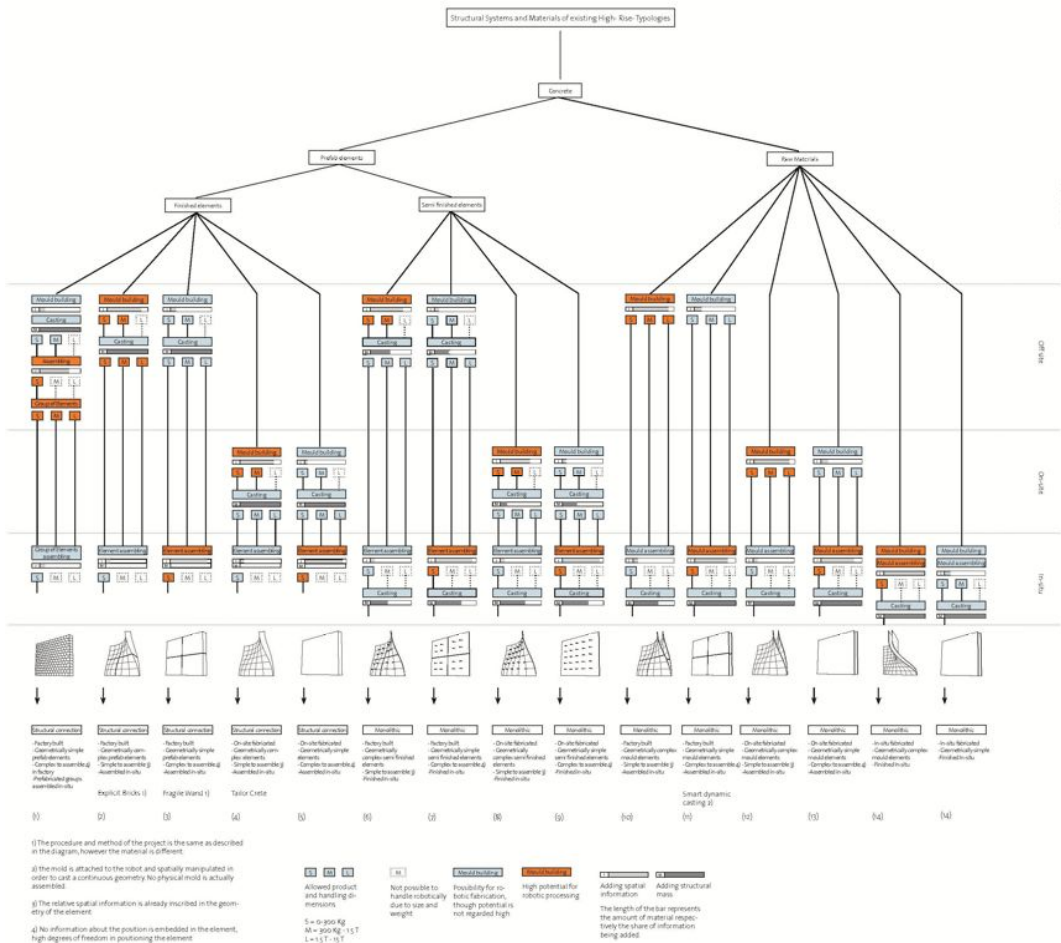
Partnerships with Industry – Case Study



ATMI Building (Techno-Ecological Institute), Jakarta

- New Low Exergy design for tropical buildings
- Incorporating landscape ecology, sustainable construction and design
- Partners were Uponor for radiant cooling and Holcim for the concrete construction
- FCL teams: Low Exergy Module, Landscape Architecture Module, Chair of Architecture and Construction

Partnerships with Industry – Case Study



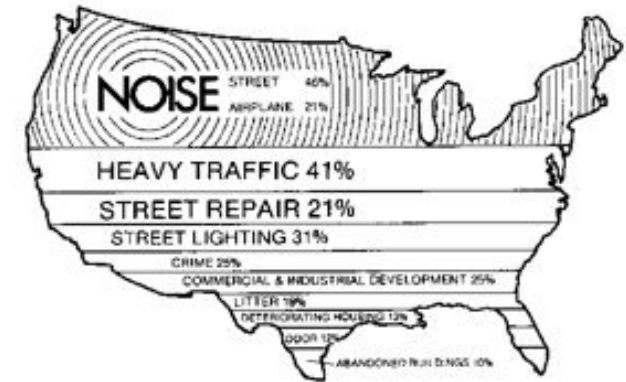
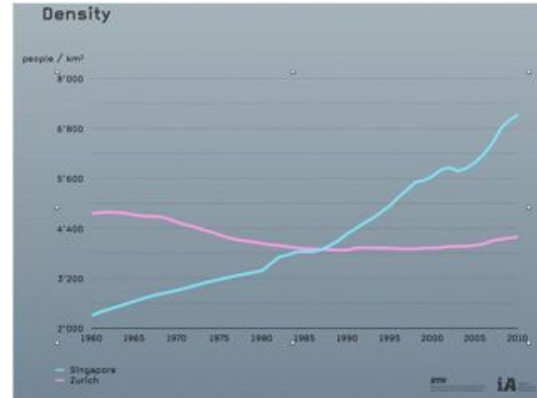
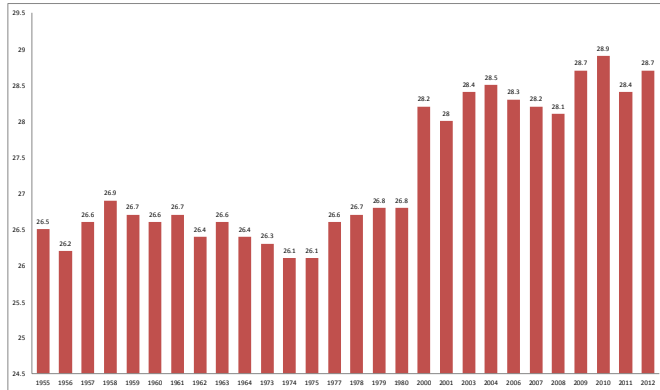
Sponsorship of 1 PhD Researcher in FCL

- 3.5 year project
- Full time (100%) Research position
- In the area of robotic fabrication
- FCL team: Architecture and Digital Fabrication Module

Diagram showing an evaluation of robotic processes in concrete construction

[Back to Map](#)

[Back to Timeline](#)



Cooler Calmer Singapore

FACTS

Contribution to Heat Flux in Singapore

- Industry (60%)
- Transportation (22%)
- Buildings (17%)
- The existing Urban Planning model

GOALS

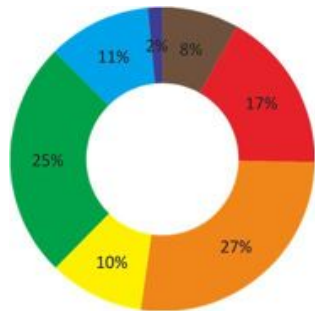
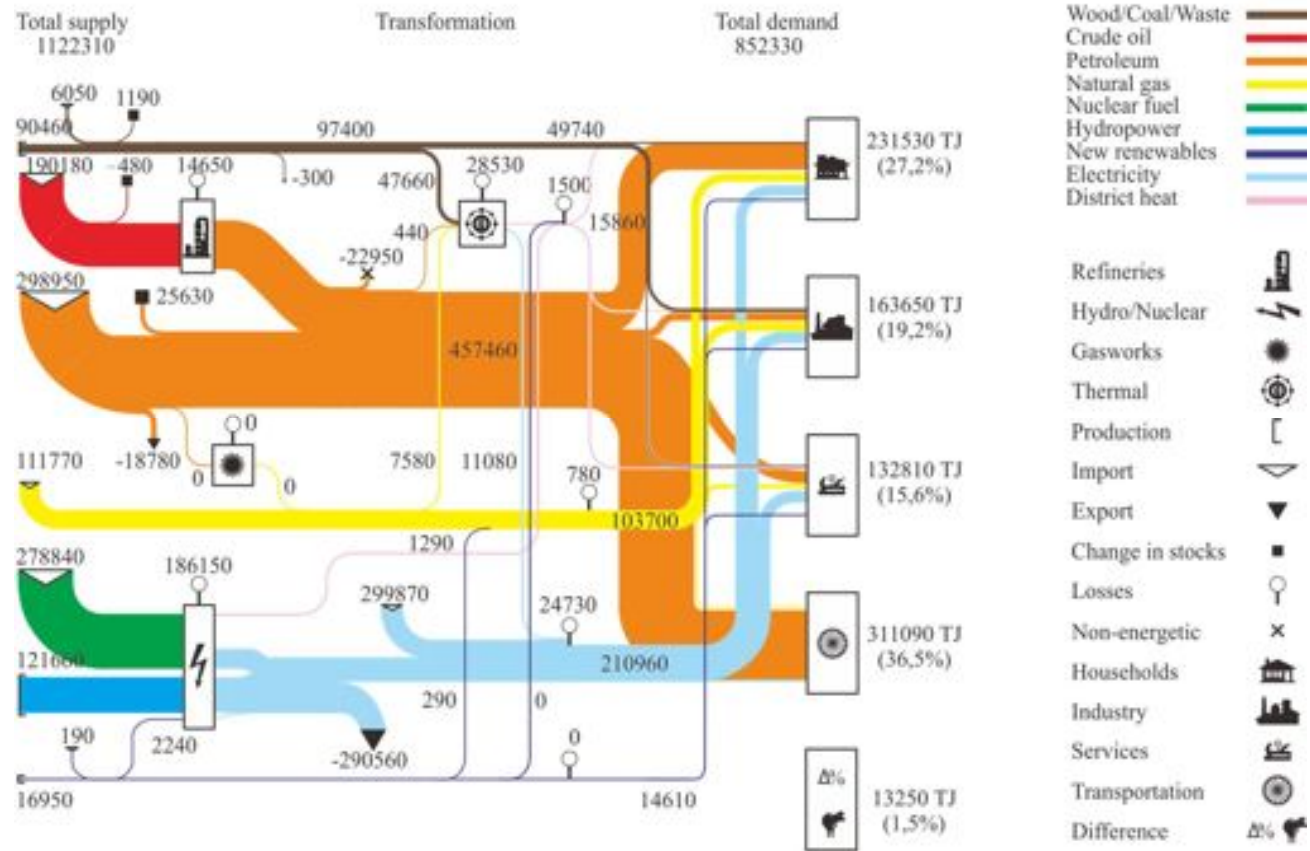
In the next 20 years

- Lower temperature
- Reduce noise
- Reduce flooding
- Increase quality of life

Energy flows in TJ for Switzerland



Population 8'014'000
 Energy dem. 852'330 TJ
 Area 41'285 km²
 Density 194/ km²
 GDP(PPP) 340 bil. US\$

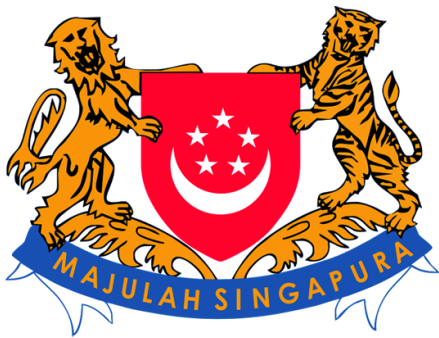


Total Primary Energy Supply (TPES)

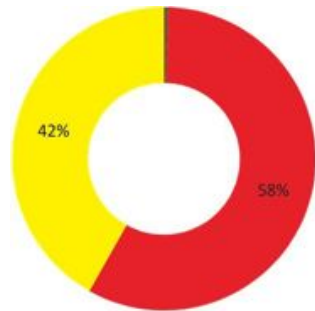
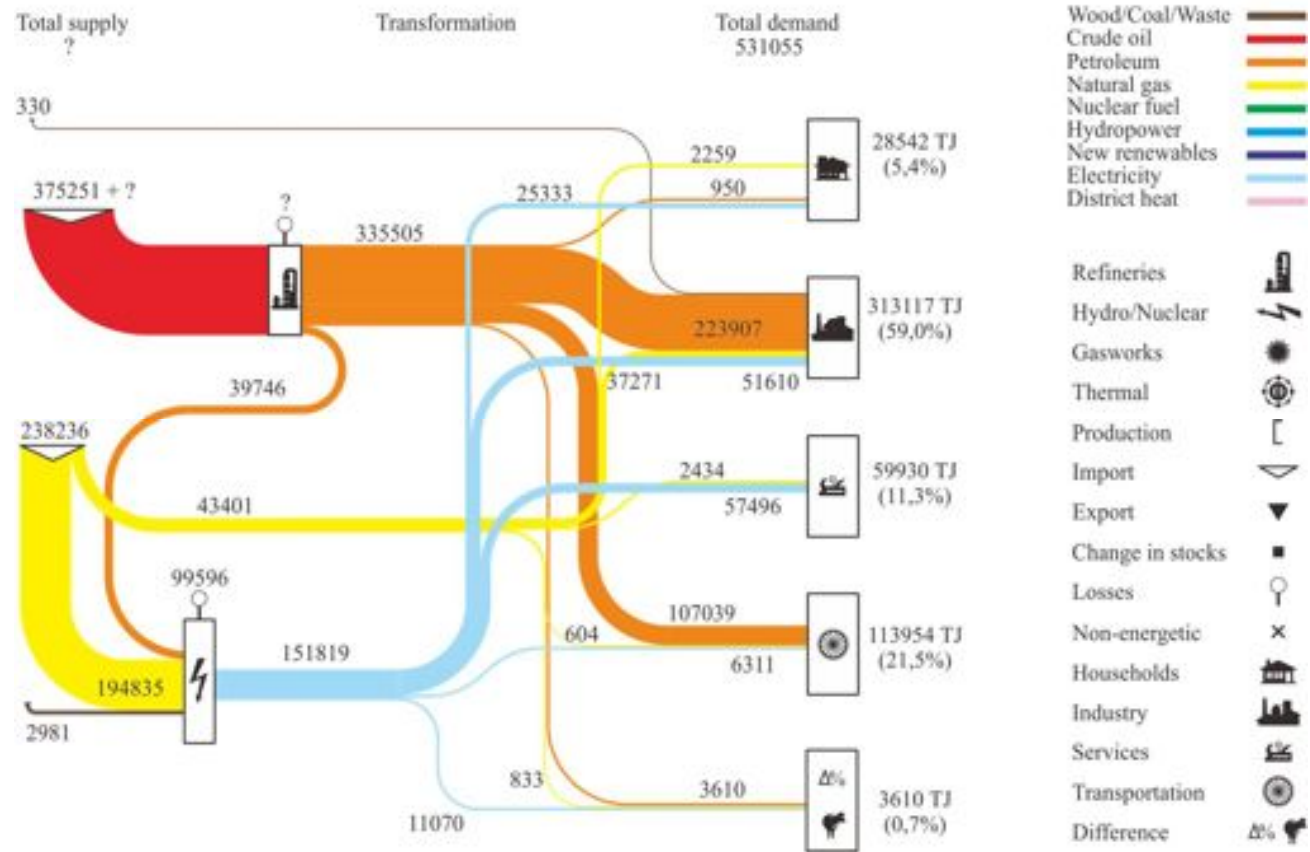
$$dE = \delta Q + \delta W = [J]$$

Image courtesy of Swiss Federal Office of Energy.

Energy flows in TJ for Singapore



Population 5'312'400
 Energy dem. 531'055 TJ
 Area 712.4 km²
 Density 7126/ km²
 GDP(PPP) 315 bil. US\$



Total Primary
Energy Supply
(TPES)

$$dE = \delta Q + \delta W$$

$$= [J]$$

ETH Singapore – Future Plans

- Start of a second Singapore – ETH Centre program on Future Resilient Systems, FRS in early 2014, supported by the Integrated Risk Centre at ETH Zürich, Swiss RE and other industries.
- Start of the third Singapore – ETH Centre programme on Future Food Security, FFS in 2015, supported by the World Food Centre at ETH Zürich, Nestlé and other industries.
- Launch of the first Massive Open Online Course on Future Cities for Asia, Africa, and South America in 2014.
- Becoming one of ETH's Premier global hubs in education, science, and technology, next to new hubs in Africa and South America.



Thank you!

<http://www.futurecities.ethz.ch>