



From Zero Emission Buildings (ZEBs) to Zero Emission Neighbourhoods (ZENs)

The role of visualisation and an integrated approach.




Illustration: Snøhetta



The Research Centre on
Zero Emission Buildings

Aoife Houlihan Wiberg
07.02.17 DTU, Lingby, Denmark



WP1 Analytical Framework for Design and Planning of ZEN

WP.1 Leader: Professor Annemie Wyckmans

Goal:

1. Develop definitions, targets and benchmarking for ZEN, based on customised indicators and data (quantitative + qualitative)
WP.1.1 Leader: Professor John Krogstie
2. Develop life cycle analysis methodology for energy and emissions at neighbourhood scale
WP.1.2 Leader: Professor Helge Brattebø
3. Develop a citizen-centred architectural and urban toolbox for design and planning of ZEN, including visualisation for decision support.
WP.1.3 Leader: Dr. Aoife Houlihan Wiberg



WP 1.3. Develop a citizen-centred architectural and urban toolbox for design and planning of ZEN, including visualisation for decision support

Mapping Citizen-Centered Architectural & Urban Toolbox for ZEN

What:

Analyse which design and planning instruments (*analogue, digital, other*) can support design of ZEN Pilot projects & Living Labs in the best holistic manner.

Why this work is important for ZEN:

Support transfer from research to planning and implementation

Year 1 Deliverables: December 2017

Report with recommendations for development of ZEN design and planning toolbox, based on systematic review of state of the art and a workshop with ZEN user partners.

3D Visualisation to improve stakeholder participation (*incl PhD*)

What:

Investigate how 3D visualisation can be used as a means to involve stakeholders in design, planning and management of ZEN Pilot projects and Living Labs

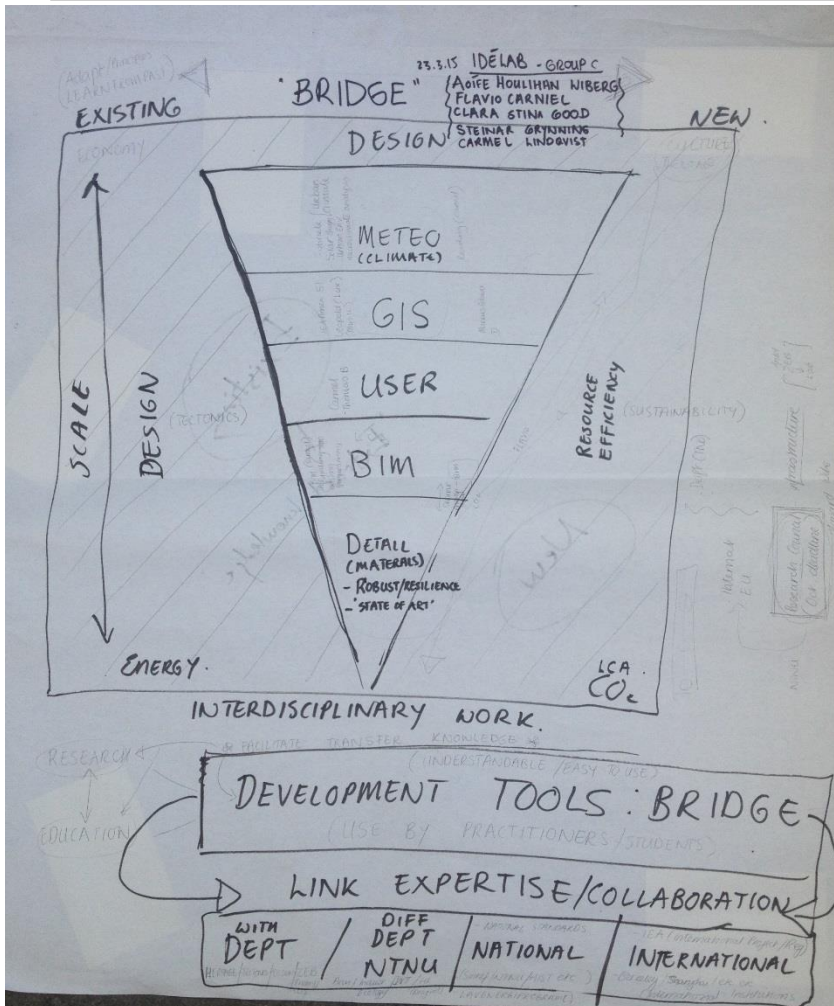
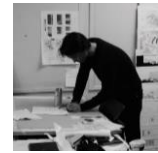
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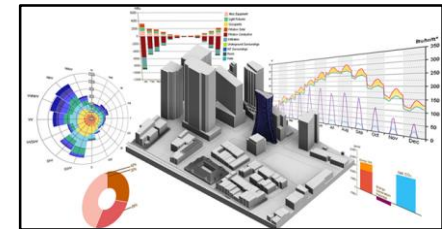
Year 1 Deliverables: December 2017

Report with recommendations for development of 3D visualisation dashboard to improve stakeholder participation in ZEN design, planning and management.

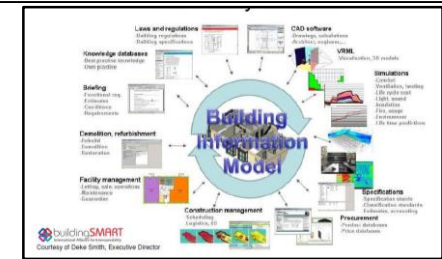
WP 1.3 Task: Develop a toolbox which can be applied to different scales of application linking Climatic/GIS/User/BIM/Details.



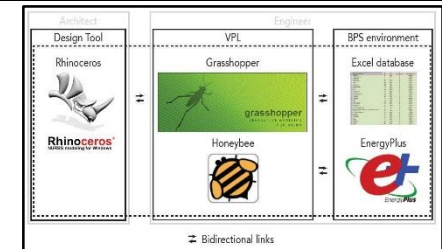
Neighbourhood GIS



Building BIM



Materials Details



'Bridge' concept – Aoife Houlihan Wiberg, Gabriele Lobaccaro et al. 2015



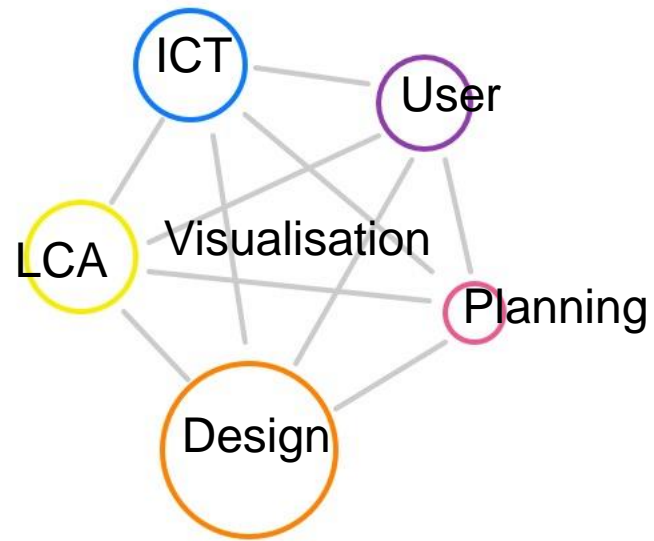
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1 Knowledge Building

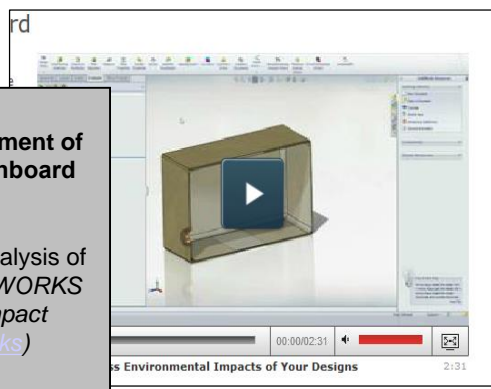
What do we need to make it happen?



TASK 1
Gain new knowledge for the development of an 'Environmental Assessment' Dashboard
 (MIT SENSEable Lab+ ZEN WP1.3)

Gain new knowledge through critical analysis of reference projects, for example, *SOLIDWORKS (Sustainability built-in Environmental Impact Dashboard)* (<https://lst.mit.edu/solidworks>)

How can this be further developed for the ambitions of WP1.3 in ZEN?



The Next Step in Advanced GIS Collaboration

TASK 2
Gain new knowledge in Visualisation for the integration of the Environmental Dashboard and Imaging Technology
 (MIT Media Lab+ ZEN WP1.3)

Gain new knowledge through critical analysis of reference projects, for example, Touch Table

Zebra Imaging Technology with MIT Media Lab
<http://www.zebraimaging.com/zebra-imaging-etching-technology/>

How can this be further developed for the ambitions of WP1.3 in ZEN?



September 2017 to June 2018
 Develop networks and knowledge in the 'state of the art'

Dec 2017: Deliver report on 'state of the art' of visualisation tools
June 2018: Possible Prototype for ZEN

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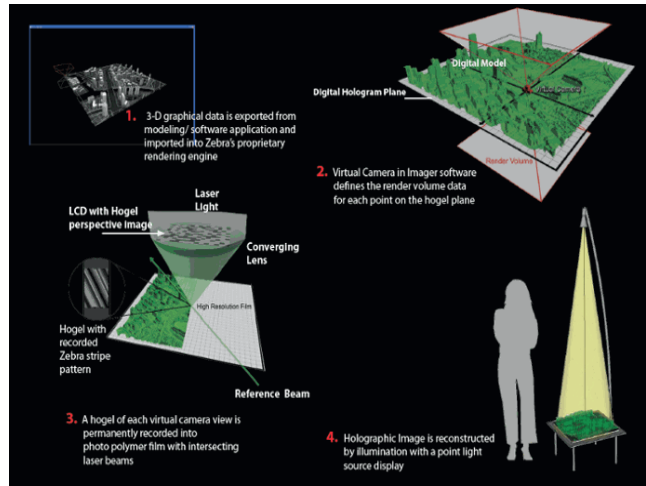
Future Ideas

Development of Interactive 3D Touch Table & Holograms



The Next Step in Advanced GIS Collaboration

*Defense Review – Northrop Grumman TouchTable
+ Zebra Imaging 3D Digital Holographic (Digital Hologram)*

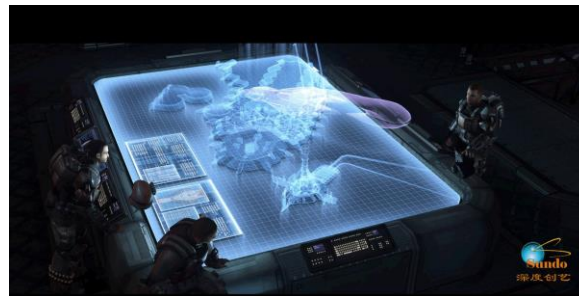


3D ZScape® 3D Hologram Creator

This tool lets you import existing 3D models from numerous 3D formats, then frame, light, and export them for use in creating a 3D holographic print for Zebra Imaging.



Camera Obscura



Gaming Technology



Microsoft HoloLens

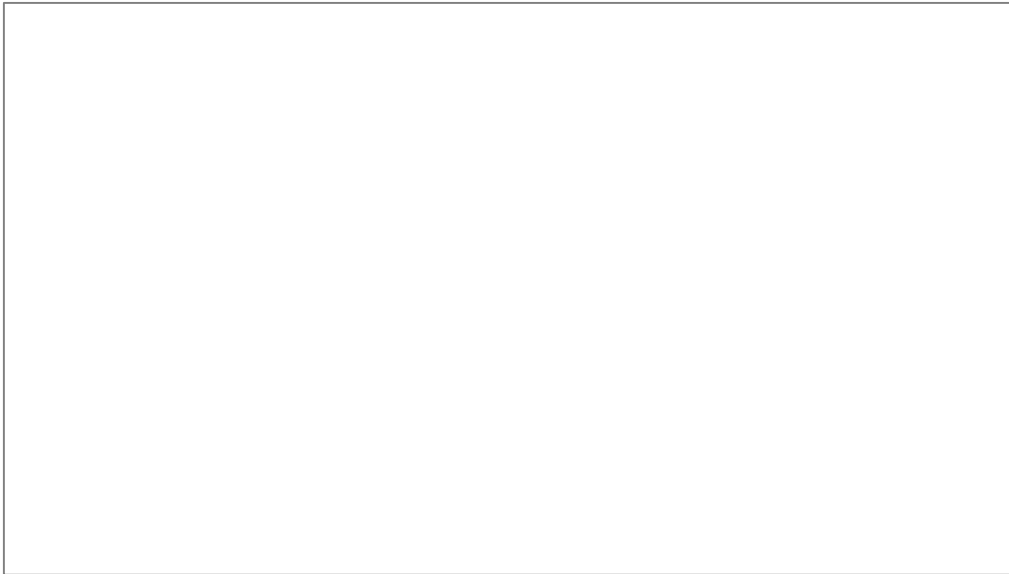


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3) Knowledge building for development of Interactive 3D Touch Table



Pathfinder – FLEXI

In FLEXI project we will use a Map table and Phoenix+ software for gathering and visualize urban geodata from the city in order to develop co-design solutions by establishing dialogue with different urban stakeholders.(i.e. municipality, real estate, land and infrastructure owners and developers, knowledge institutes, innovators)

FLEXI will explores the market potential for geo-ICT-supported (urban representation, visualisation, modelling and collaboration capabilities) and geodesign-based approaches, which provide stakeholders with a better overview and better decision support for their prioritization of future resources.

(Grant Application: Judith Borsboom + Gabriele Lobaccaro, NTNU)

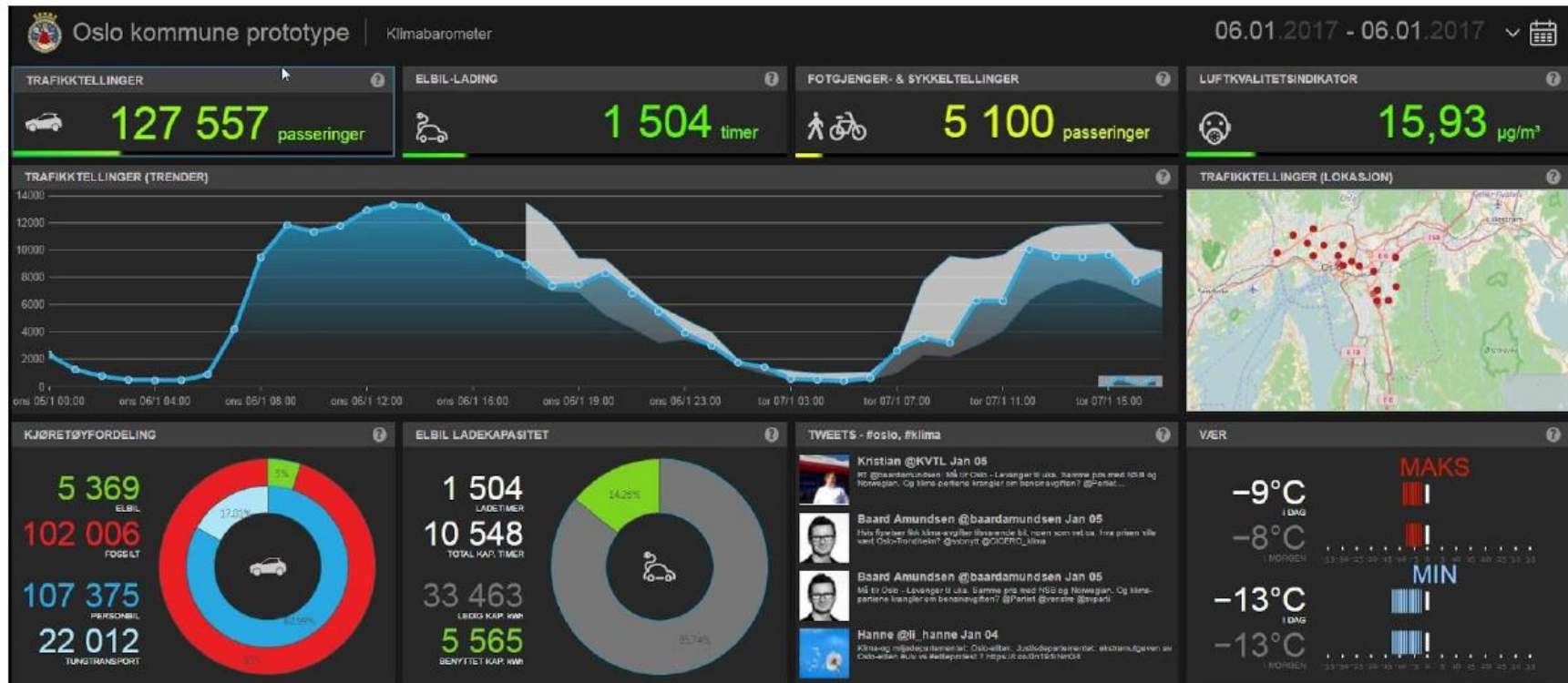


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Knowledge building to develop a DASHBOARD for ZEN Trondheim - City Dashboard



Powel & Trondheim Kommune (courtesy of Kristin Gabrielsen)

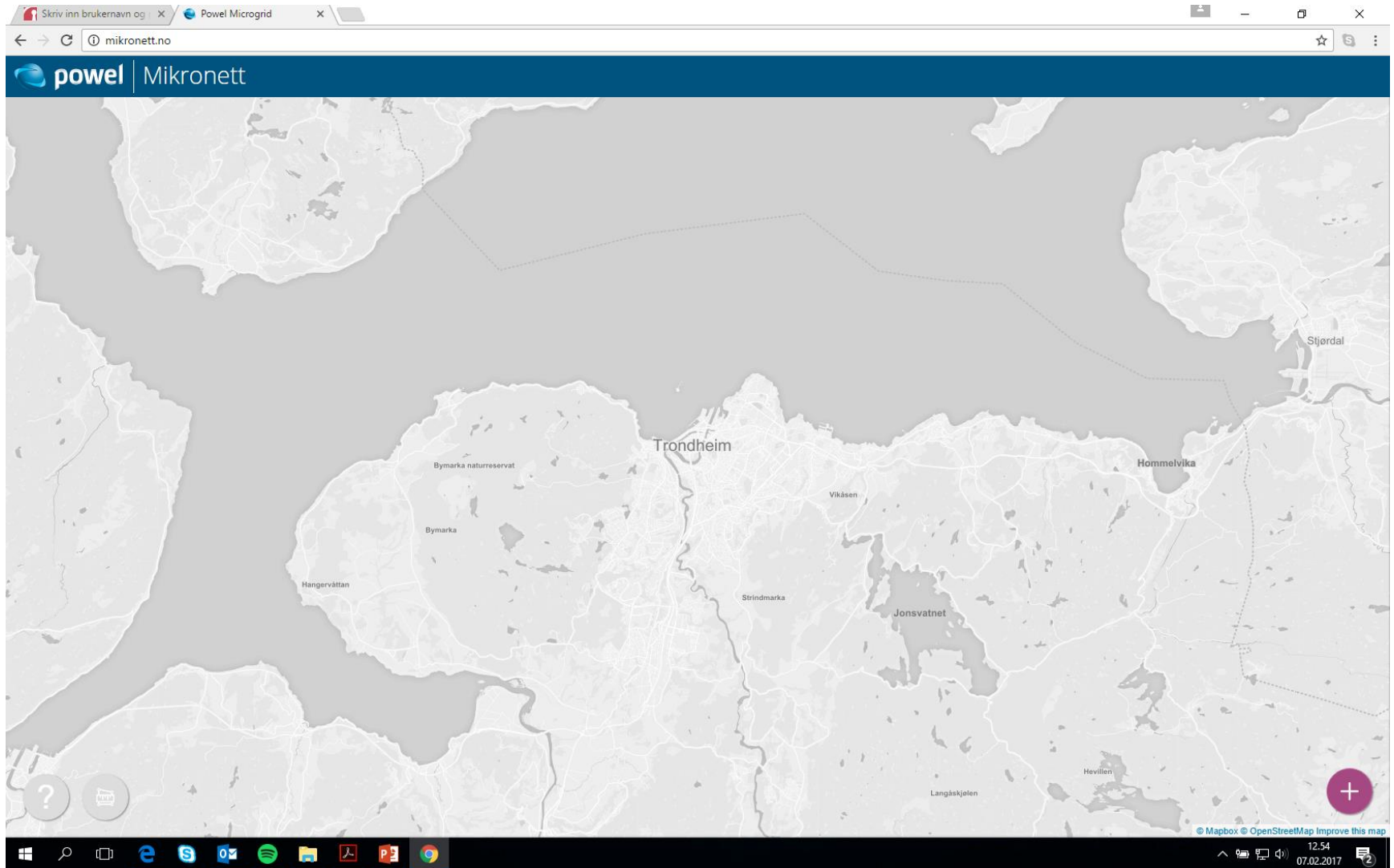


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3) Knowledge building other reference projects Mikronett.no (Powel.no)



3) Knowledge building other reference projects Mikronett.no (Powel.no)

The screenshot shows a web browser window with the URL mikronett.no. The page features a map of Trondheim, Norway, with an orange circle highlighting the Elgeseter area. Below the map, the website displays the following information:

Elgeseter mikronett

- 72,4 GWh** (103 turbiner (300 kW), 0 turbiner (10 kW))
- 726,5 MWh** (788 kWp solcelle)

Detaljer:

- 73,2 GWh produksjon
- 19,3 MWh batterilager
- 2 t batteri ved topplast
- 3 260 personer
- 1,31 km²
- 50,9 GWh forbruk
- 9,2 MW topplast

Annuitetskostnad 29,2 MNOK / år

- 62 eneboliger
- 615 rekkehus & tomanns
- 1691 leiligheter
- 0 fritidsboliger
- 37 offentlig bygg
- 26 næringsbygg
- 2 industribygg
- 1 fiskeri- & landbruksbygg



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3) Knowledge building other reference projects Mikronett.no (Powel.no)

7.2.2017

Powel Microgrid

Elgeseter mikronett



72,4 GWh

103 turbiner (300 kW)
0 turbiner (10 kW)



726,5 MWh

788 kWp solcelle

Detaljer:

73,2 GWh produksjon

19,3 MWh batterilager

2 t batteri ved topplast

3 260 personer

1,31 km²

50,9 GWh forbruk

9,2 MW topplast

Annuitetskostnad 29,2 MNOK / år

62 eneboliger

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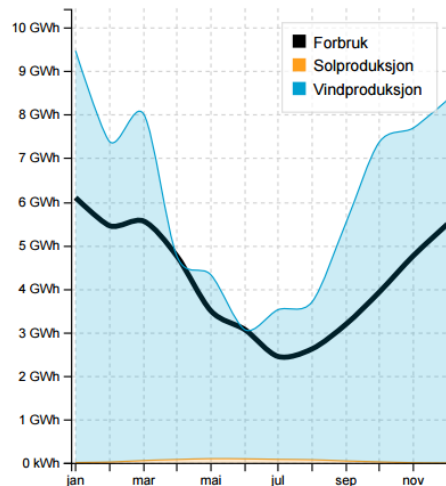
0 fritidsboliger

37 offentlig bygg

26 næringsbygg

2 industribygg

1 fiskeri- & landbruksbygg



Stablet produksjonsprognose sammenlignet med en gjennomsnittlig forbrukskurve fordelt på et år.

Når skal du velge mikronett?

Det er flere grunner til å benytte mikronett. For å hjelpe vurderingen av ditt område kan du ta stilling til følgende spørsmål.

Er infrastrukturen i området utdatert?

Et uavhengig mikronett kan være et rimelig alternativ til (re)investering i infrastruktur der det er mange dyre komponenter til få forbrukere. Særlig vil mikronett være hensiktsmessig om befolkningsveksten er negativ eller uforutsigbar, da mikronett er modulært og flyttbart. Dersom reinvesteringer er nødvendig som følge av økt topplast i området, kan mikronett også benyttes til å avlaste infrastruktur og å øke fleksibiliteten i nettet.

Har det oppstått endringer som påvirker leveringssikkerheten?

I områder der store nye utbyggelser er nødvendig for å ivareta eller øke leveringssikkerheten, kan mikronett være et godt alternativ. Det kan kjøres i øydrift og levere strøm selv om resten av nettet har et strømbrodd. Dermed vil mikronett også være et klokt alternativ i områder med mye uvær, strømbrodd og prioriterte forbrukere.

Er det en økende andel av småskala og lokale energiproducenter i området?

Mikronett kan effektivt integrere lokal fornybar produksjon fra private husholdninger og småskala aktører. Mikronettet kan ivareta overskuddsenergien og øke fleksibiliteten i nettet gjennom året.

Powel hjelper deg videre

Med denne rapporten er mye av jobben gjort. Du har valgt et interessant område for mikronett og har sett at det kan lønne seg å vurdere det nærmere. Mulighetsstudien her er basert på månedsverdier og en estimert forbruksprofil. Med mer detaljert informasjon om ditt scenario kan vi designe et skreddersydd mikronett for ditt behov. Vi har en unik kompetanse innen design av mikronett, og når mikronettet er implementert har vi verktøy for å optimere den daglige driften.

Informasjon om utregningene

Modellen benytter data fra Statistisk Sentralbyrå, NASA, PVGIS og leverandører av hardware for å beregne optimal oppbygning og tilhørende kostnad av mikronettet. Kostnaden er beregnet ved hjelp av standard annuitetsmetode med 8% rente, en levetid på 25 år for produksjonsanlegg og 15 år for lagring. Den estimerte investeringskostnaden for mikronettet er 410,5 MNOK. Vedlikeholdskostnader og inntekt fra energisalg er tatt med i beregningen.

Ta kontakt med oss i dag for en uforpliktende prat om potensialet i ditt nettområde.

mikronett@powel.no

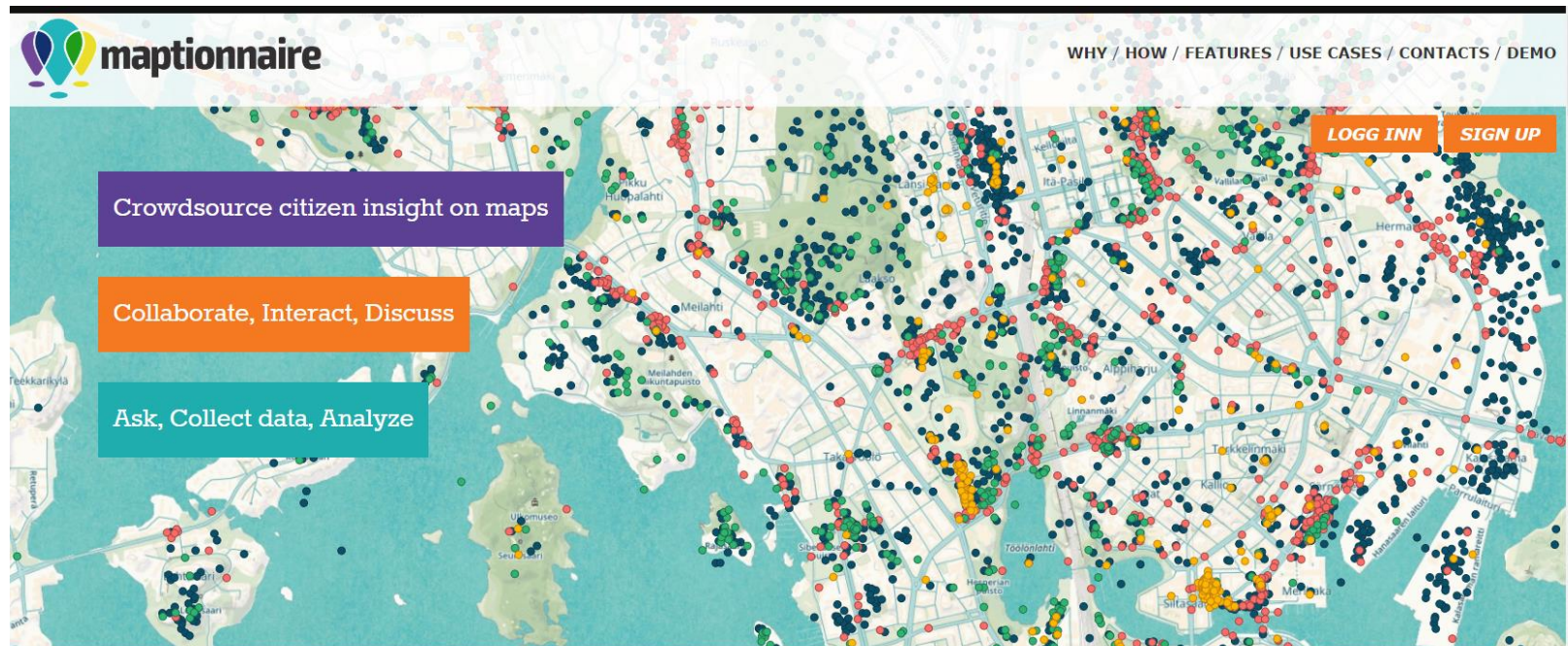
<http://mikronett.no/>

powel



1/1

Maptionnaire – Chalmers (Mapita.fi)



WHAT

Maptionnaire is a SaaS for creating your own map-based questionnaires and civic participation platforms easily.

International Collaboration - INTPART/ENERGIX?



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CityBES Lawrence Berkeley Laboratory

CityBES A Web-based Platform to Support City-Scale Building Energy Efficiency

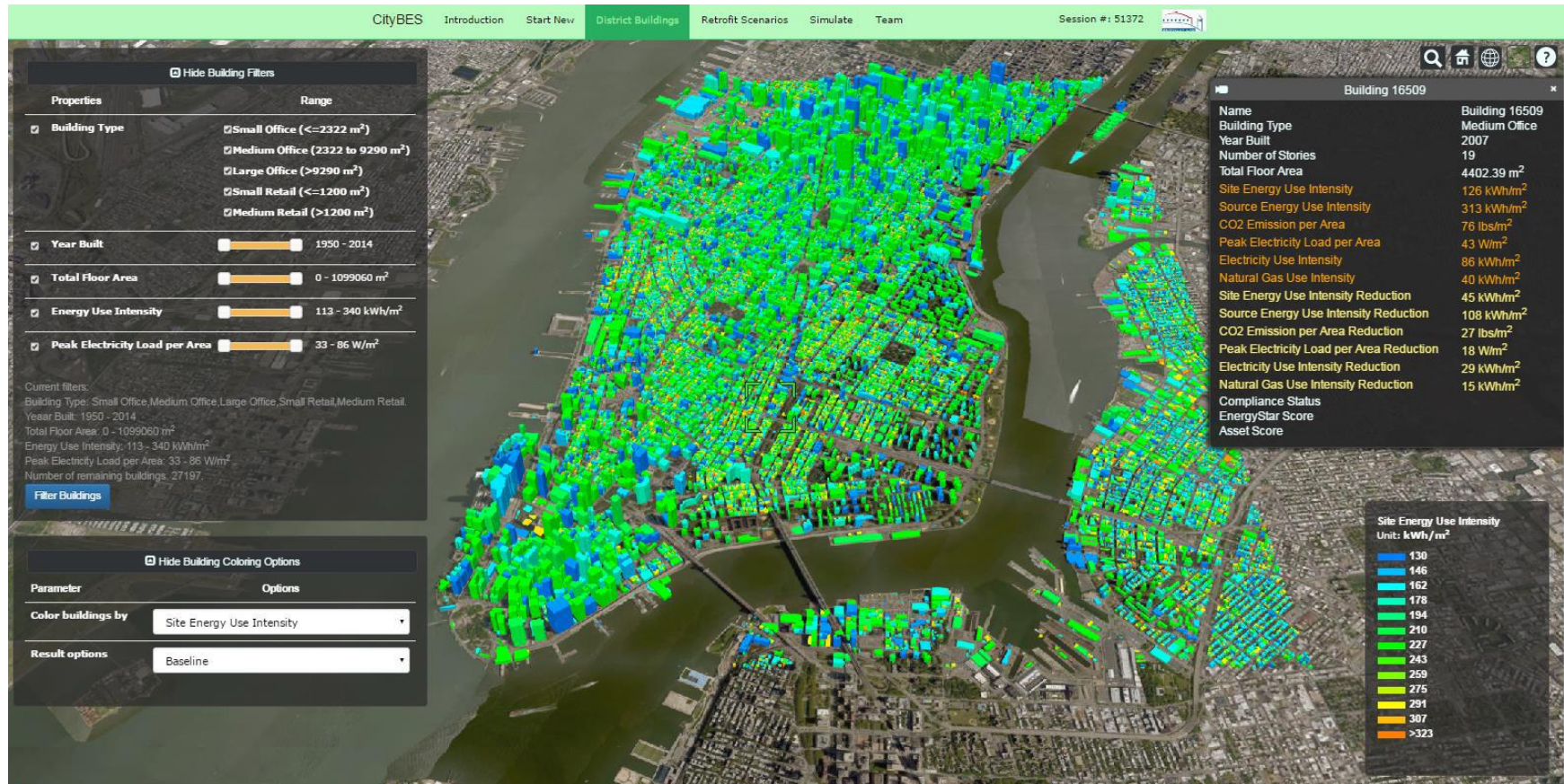


Figure 1: CityBES: Buildings in Manhattan New York (for illustrative only, using mockup building data)

Dr. Tianzhen Hong & Dr. Paul Wetter, LBL



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CityBES Lawrence Berkeley Laboratory

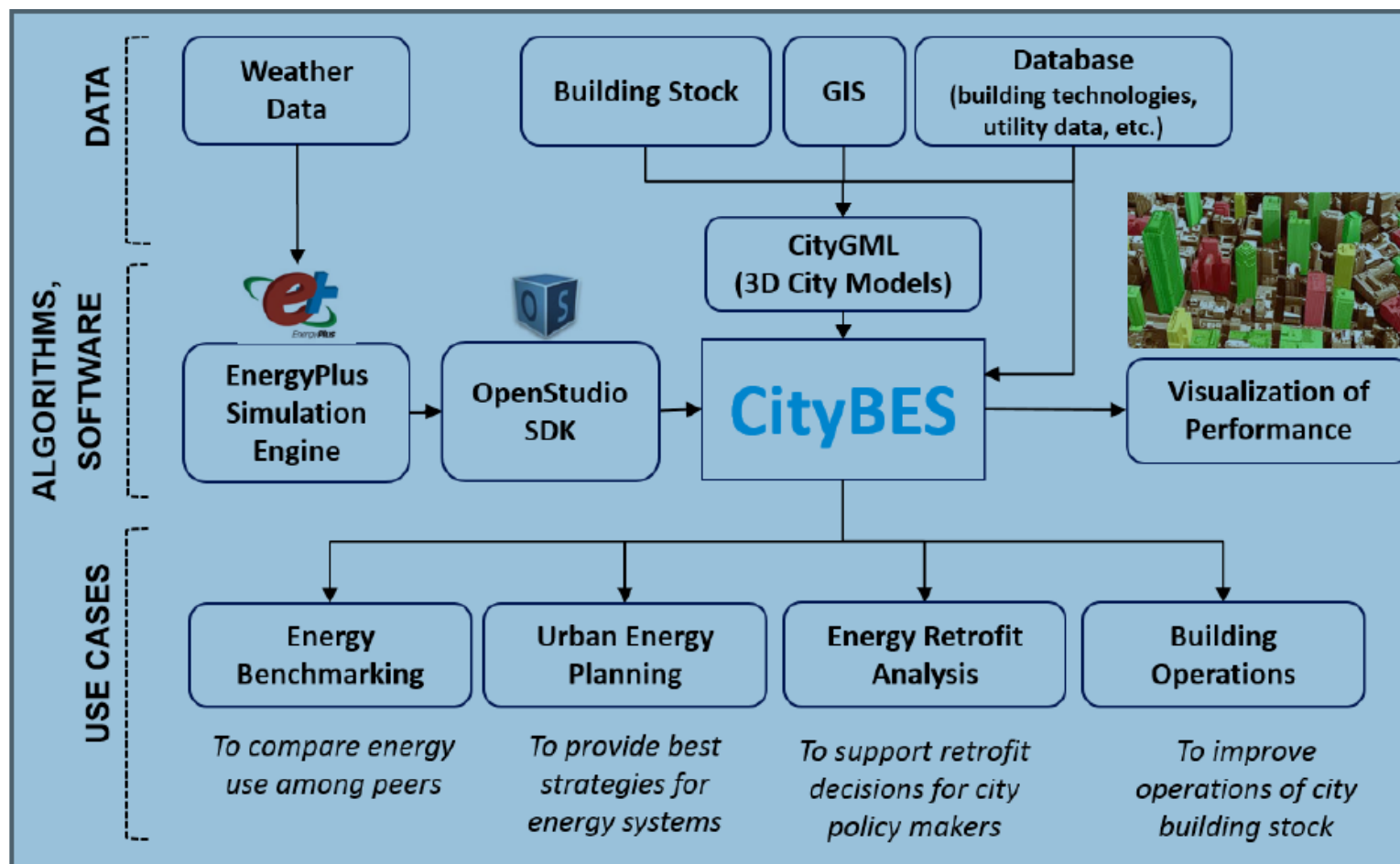
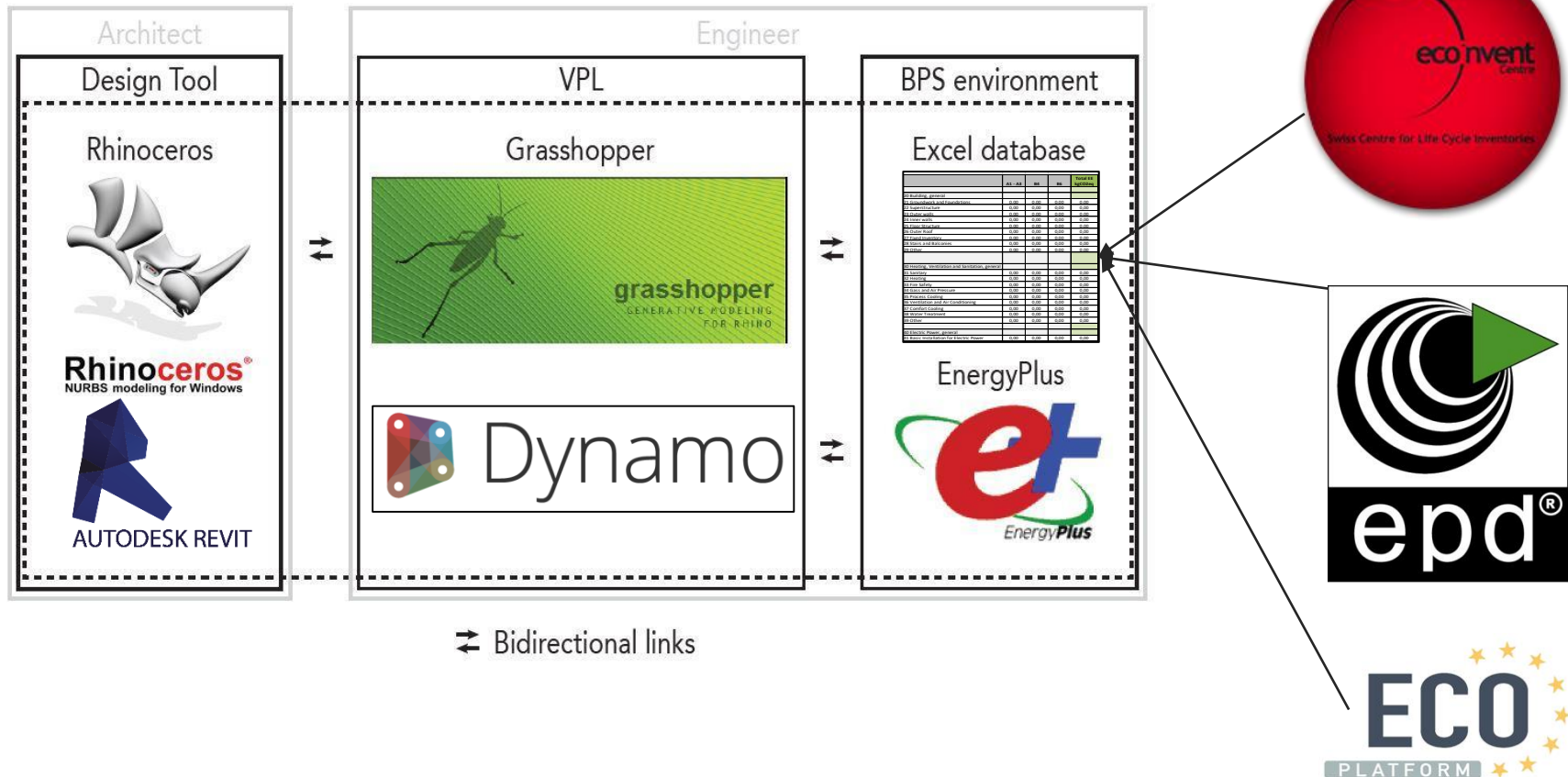


Figure 2: Software Architecture of CityBES

Dr. Tianzhen Hong & Dr. Paul Wetter, LBL

1) Further development of an integrated LCA model with visual feedback

Generic & Specific Data



NORWAY-SINGAPORE ENERGY RESEARCH WORKSHOP – FEB 20-22, 2017

OBJECTIVES FOR THE WORKSHOP:

1. For the attending Norwegian and Singaporean research institutions to identify and establish areas for research cooperation. Clarification of research focus and approaches; joint research project opportunities; common goals and drivers.
2. For Norwegian and Singaporean companies to interact with the research groups to both gain insights into the state-of-the-art research and technology advances; but also to influence the research focus to support commercial interest. Identify and discuss project opportunities with company participation.
3. For the research funding organizations such as RCN, National Research Foundation and A*STAR to identify and discuss options for joint or bilateral funding of research projects and programs.
4. To facilitate discussions on trends, road maps, strategies for business opportunities in the wider Southeast Asian energy markets.

EXPECTED OUTCOME OF THE WORKSHOP:

1. Norwegian and Singapore parties that have already established MoUs for research collaboration (e.g. NTNU vs. ERI@N and Tel-Tek vs. ERI@N) will have concrete plans for collaboration; identified problem statements, personnel, modes for collaboration etc.
2. Norwegian institutions without existing MoUs will have a clear understanding of the research collaboration opportunities and interests in Singapore.
3. Singaporean institutions will have a clear and comprehensive understanding of the relevant Norwegian energy research community.

International Collaboration – CREATE application?

CREATE

Campus for Research Excellence And Technological Enterprise

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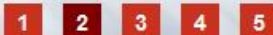
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HUJ Launches Research and Innovation Centre

The Singapore-HUJ Alliance for Research and Enterprise (SHARE), marked its launch on September 19 ...



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RESEARCH

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ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE



Established in collaboration with MIT

CREATE Campus for Research Excellence and Technological Enterprise

Welcome to CREATE

The Campus for Research Excellence And Technological Enterprise (CREATE) is an international research campus and innovation hub. Home to a vibrant research community, CREATE hosts the National Research Foundation, interdisciplinary research centres from top universities.



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The three underlying thrusts for EcoCampus are:



RESEARCH

R&D + Demonstration + Deployment
as the key focus



LIVING LAB

250+ hectares campus; 100+ buildings
1.1M m² built area



**INDUSTRY
COLLABORATION**

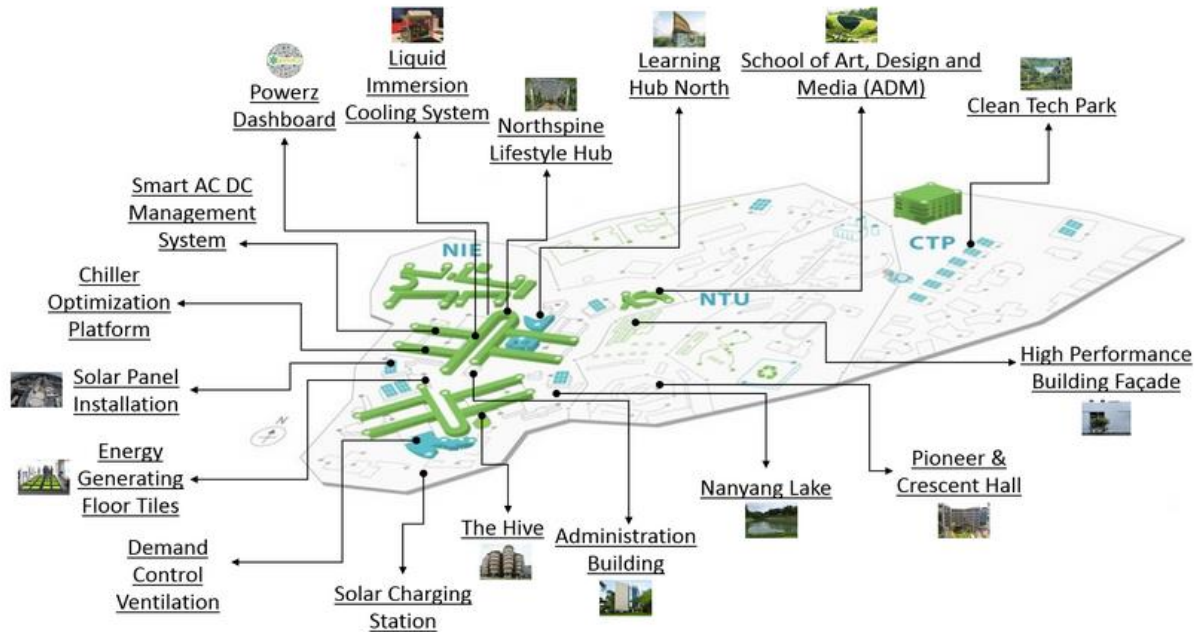
Partnering MNCs, local companies
and generating spin-offs

Ecocampus

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Ecocampus

Ecocampus Tour



Industry Collaboration

The EcoCampus Initiative aims to be the leading example for high Impact energy efficiency and sustainability for urban developments in Singapore. With an overarching vision to be the greenest eco-campus in the world, the goal is to develop a framework to achieve 35% reduction in energy, carbon, water and waste intensity. Apart from achieving the ambitious goal, it will provide a platform for research, education and demonstration with an emphasis on industry participation. The EcoCampus Initiative encompasses a substantially large region in the west of Singapore with existing facilities at NTU's Yunnan Garden Campus and JTC's CleanTech Park as well as new developments in the neighbourhood.

Type of Projects

The key research drivers for EcoCampus are Urban solutions related to energy efficiency and sustainability with a clear niche on solutions for the hot tropical climates such as Singapore. The 5 key RD&D Focus areas for energy research considered are as follows:

- 1) Green Building Systems for the Tropics
- 2) Renewable Energy integration & Smart Grids
- 3) Sustainable Urban mobility
- 4) Energy Information Analytics
- 5) User Behaviour for Sustainability

EcoCampus RD&D Projects

Topic	Testbed location	Industry partner
An Interactive solution to Improve the Energy Efficiency using User Behaviour and Gamification	Campus-wide	
Demand Control Ventilation for Energy Reduction in Laboratories	SPMS labs	
Liquid Immersion Cooling for Data Centres in the Tropics	HPCC	
High Energy Performance material for tropical building envelopes	Residential Hall-4	
Intelligent, Demand-Based, Algorithmic Chiller Optimization for Buildings in the Tropics	N3.1 chiller plant	
Smart AC and DC Management Systems for Green Buildings	CTO	
Building-wide Wireless Sensor Network for indoor air quality monitoring	CTO	
DC Renewable Connected Building Grid for Wireless Intelligent LED Lighting System (WILLs)	CTO	
Quick charging autonomous shuttle vehicles for tropical urban cities	CTO	
Demonstration of a full package Vanadium Redox flow battery solution for back-up power	CTO	
Design, Development and Demonstration of a Microgrid Power Mix Management solution	CTO	
Chilled Ceiling concept for energy efficient indoor cooling in tropics	NTU and CTP	
Shared personal mobility solution (Smart e-bikes)	Campus	
A Smart Community Solution for Energy Management	Staff residences	
Smart Community life-cycle process using modelling, visualization and simulation tools	Academic campus	

ERI@N Accelerator Programme

Programmes

ERI@N Accelerator Programme

Share

ERI@N is strategically placed in the wider domain of clean energy and energy efficiency that focuses on applied research and deployment with targeted industry participation - which provides the opportunity to understand problems and accordingly work on relevant solutions that are practical, deployable, cost effective, scalable and marketable.

The aims of the ERI@N Accelerator Programme are:

- Accelerate the transition from lab to commercialization for technologies aligned with the core vision and mission of ERI@N
- Provide facilities, seed funding, mentorship for staff and students to take their inventions or inventions from around the world to the market place
- Support the development an entrepreneurial and innovation culture across NTU and Singapore.

To date there are about 13 start-ups which have spun out of ERI@N. The focus ranges from Materials, Energy Storage, Internet-Of-Things, Software as a Service, Power Electronics, Air-Condition and Mechanical Ventilation, among others.



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Current Projects



Industry Collaborator:



Title:	Powerz – Garden your Campus @ NTU
Company:	ENGIE Lab Singapore
Test bedding Site:	NTU Campus
Start Date:	1 st Oct 2014
Duration:	1 Year
Description:	POWERZ is an real-life experimentation, designed to make people act for the energy efficiency of the NTU campus in a fun way. By joining this game, people will take part in an energetic journey to decrease the consumptions related to various electricity usages (such as air conditioners) of the NTU Campus.
Demonstration site:	Dashboard on Campus and Powerz App
Project Status	Completed - Download Summary Of Sociological Study And Data Analytics Of Experimental Phase (Feb - Jun 2015) here: Summary.pdf

Energy Research Institute @NTU

Building-Modeling and Simulation lab



This simulation lab is located at CleanTech One building, level 5 with the purpose of creating a state of the art lab specialized in building modelling & simulations. The objective and vision of the simulation lab are as follow:

- Create a central data base for our existing/future research projects for easier accessibility within the SSBT team
- Showcase our capabilities and expertise on building modelling and simulations
- Educate and share modelling & simulation knowledge amongst internal NTU staff
- Perform research, develop & deploy new simulation tools to fill the gap of existing ones and simplify the process of simulations
- Foster collaboration with external parties for advance building modelling and simulations

Technologies available

5 set of High Performance Computers, an AR (Augmented Reality) and a VR (Virtual Reality) system have been set up in this lab to address above mentioned objective and vision.

Note: Aoife + Yann Grynberg (ERI@N), in charge of Zero Energy buildings for Singapore, are in discussion about developing a project to adapt ZEB/ZEN for Singapore conditions (Tropics)

Singapore – ETH Centre

ETH zürich

(FCL) FUTURE CITIES LABORATORY 未来城市实验室

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Singapore-ETH Centre

The Singapore-ETH Centre for Global Environmental Sustainability was established in Singapore in 2010 as a joint initiative between ETH Zurich and Singapore's National Research Foundation (NRF), as part of the NRF's CREATE campus. The Singapore-ETH Centre is an institution that frames a number of research programmes, the first of which is the **Future Cities Laboratory (FCL)**, followed by the **Future Resilient Systems (FRS)**.

The Singapore-ETH Centre aims to strengthen the capacity of Singapore and Switzerland to research, understand and actively respond to the challenges of global environmental sustainability. It is motivated by an aspiration to realise the highest potential for present and future societies. The centre serves as an intellectual hub for research, scholarship, entrepreneurship, postgraduate and postdoctoral training. It actively collaborates with local universities and research institutes and engages researchers with industry to facilitate technology transfer to benefit the public.

Note: Aoife + Professor Arno Schleuter (ETH-Singapore), are in discussion about developing a project through CREATE partnership to work on the issue of data visualisation and the development of a toolbox for ZEN part of her ZEN work.

CREATE

ETH zürich



ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE



National University of Singapore



NANYANG TECHNOLOGICAL UNIVERSITY



SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

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CIVAL (Collaborative Interactive Visualisation and Analysis Laboratory)

Increasing the impact of the FCL through visualisation and interaction-based applied research, including prototype development and research support



CIVAL facilitates the usage of ICT-based research infrastructure at the FCL, specifically Value Lab Asia, for research, education and communication. *Image: CIVAL, 2016*



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Value Lab Asia @FCL



The Value Lab Asia (VLA), together with its companion space in Zurich, is a central infrastructure for research, education and communication at the Future Cities Laboratory. It is a collaborative, digitally augmented environment that serves a wide range of applications, such as participatory urban planning and design, stakeholder communication, information visualisation and discovery, remote teaching and conferencing.



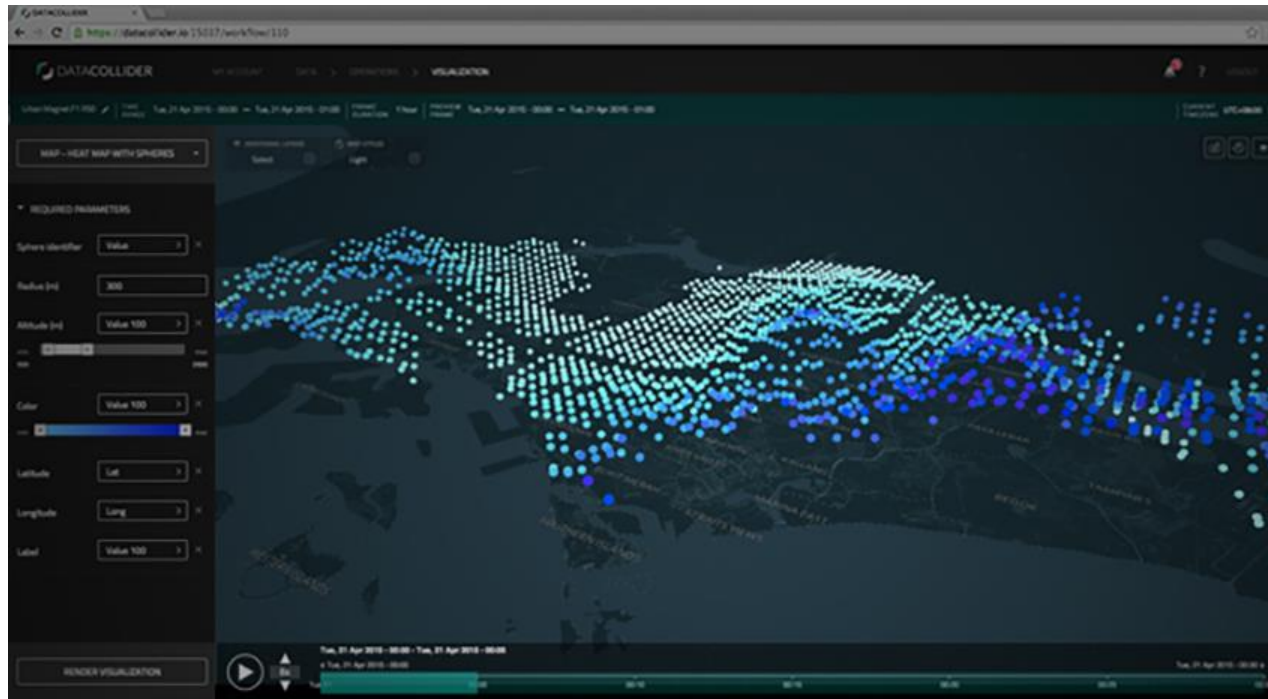
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MIT LIVE Singapore

LIVE Singapore! is a project of SENSEable City Lab and part of the Future Urban Mobility research initiative at the Singapore-MIT Alliance for Research and Technology (SMART), and funded by the National Research Foundation (NRF) of Singapore.



MIT | senseable city lab...

SMART

FUTURE URBAN MOBILITY

In collaboration with:

censam

Technical Partners

CHANGI
airport singapore

COMFORTDELGRO

National Environment Agency
Our Environment · Sustainable Singapore

PSA
The World's Port of Call

SingTel

SP SERVICES
Solutions & Support from Singapore



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Thank you

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