

# Energy in Buildings group

## Participants:

**Prof. Annemie WYCKMANS**

**Prof. Vojislav NOVAKOVIC**

**Assoc. Prof. Rolf André BOHNE**

**Assoc. Prof. Aoife Houlihan WIBERG**

**PhD Researcher Clara GOOD**

**Assoc. Prof. Luca FINOCCHIARO**

**Postdoc Researcher Gabriele LOBACCARO**

**Prof. Arild GUSTAVSEN**

**PhD Researcher Yu WANG**

**Prof. Hans-Martin MATHISEN**

**Prof. Bjørn Petter JELLE**

**Prof. Ruzhu WANG**

**Prof. Yanjun DAI**

**Prof. Yong LI**

**Assoc. Prof. Tianshu GE**

**PhD Researcher Jinfeng CHEN**

**+ several visitors ☺**

# PhD Defence (Usman DAR)

**Main Supervisor:** Prof. Vojislav Novakovic

**10:15 – 11:00** Trial lecture: Energy Supply and Heat Recovery in Passive Houses in Cold Climates – Opportunities and Challenges

**13:15 – 14:00** Influence of Occupants' Behaviour in the Performance of Net-Zero Emission Buildings

# Introduction to ZEB Living Lab, and construction site visit (Arild GUSTAVSEN)

Establishment of Research Buildings at NTNU –  
ZEB Living Lab and ZEB Research Cells



ZEB Living Lab – A dwelling for user-Technology interaction studies



ZEB Research Cells for research and development of ZEB technologies



Cooperation  
ZEB Living Lab

+

SJTU Green Energy  
Laboratory:

- Information from solar equipment manufacturers
- Testing the most promising solar equipment in ZEB Living Lab and in Green Energy Lab

**ZEB** The Research Centre on  
Zero Emission Buildings



上海交通大学  
Shanghai Jiao Tong University



JRC Workshop at NTNU, June 26 - 28 2014



NTNU - Trondheim  
Norwegian University of  
Science and Technology

# Hybrid PV/T systems in zero emission buildings (Clara GOOD)

Different (but complimentary) perspectives  
towards Zero Emission Buildings and Neighbourhoods

- Environment
  - Cities/ urban areas
  - Rural areas
- Types of buildings
  - New buildings
  - Refurbishments
  - Heritage buildings
  - High rise/low rise buildings
  - Residential/non-residential
- Energy systems
  - Heating and/or cooling demand
  - Auxiliary energy sources
  - Grid-connection/standalone
- PV/T system
  - PV/T technology
  - Building integrated/building added
  - Producer



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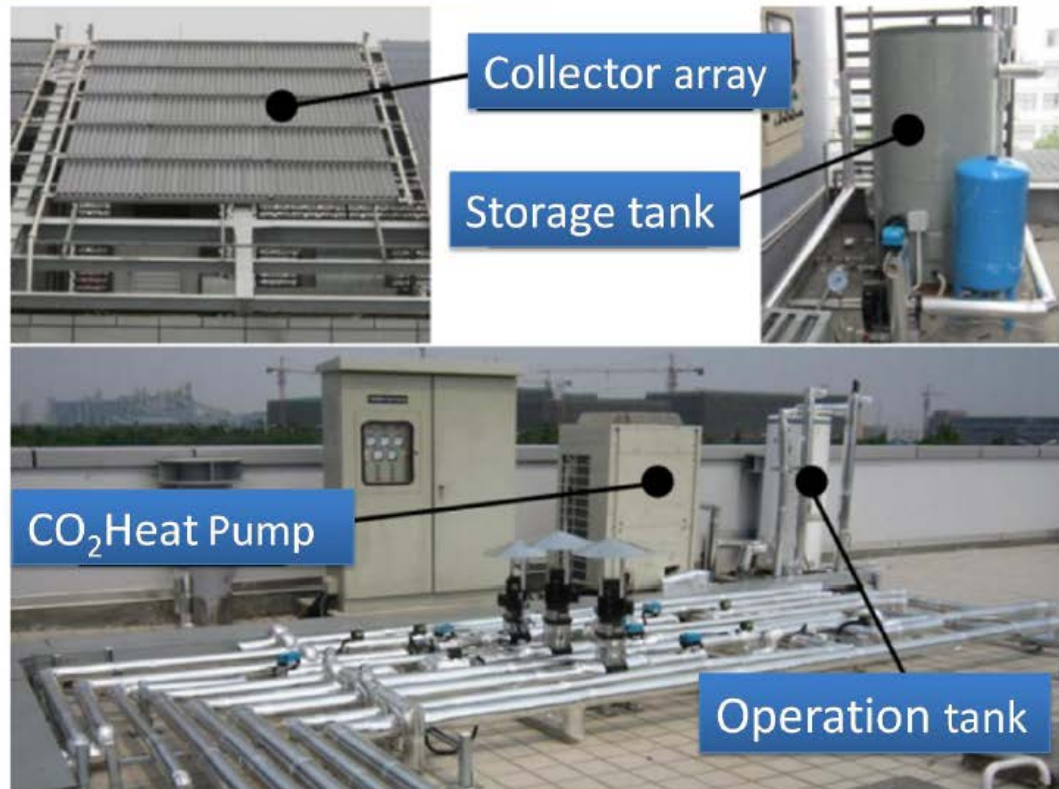


# Simulation and optimization of a solar-combi system based on TRNSYS and modeFRONTIER (Jinfeng CHEN)



## 1. Introduction of system & model

### 1.1 System diagram



# Hybrid PV/T systems in zero emission buildings (Clara GOOD)

## Accepted:

Optimization of solar energy potential for buildings in urban areas – a Norwegian case study (Clara Good, Gabriele Lobaccaro, Siri Hårklau) Presented at Renewable Energy Research Conference (RERC) 2014, Oslo; Submitted to Energy Procedia (in review)

A comparative study of different PV installations for a Norwegian nZEB concept (Clara Good, Aiofe Houlihan Wiberg, Torhildur Kristjansdottir, Laurent Georges) Accepted for oral presentation at Eurosun 2014, Aix-les-bains

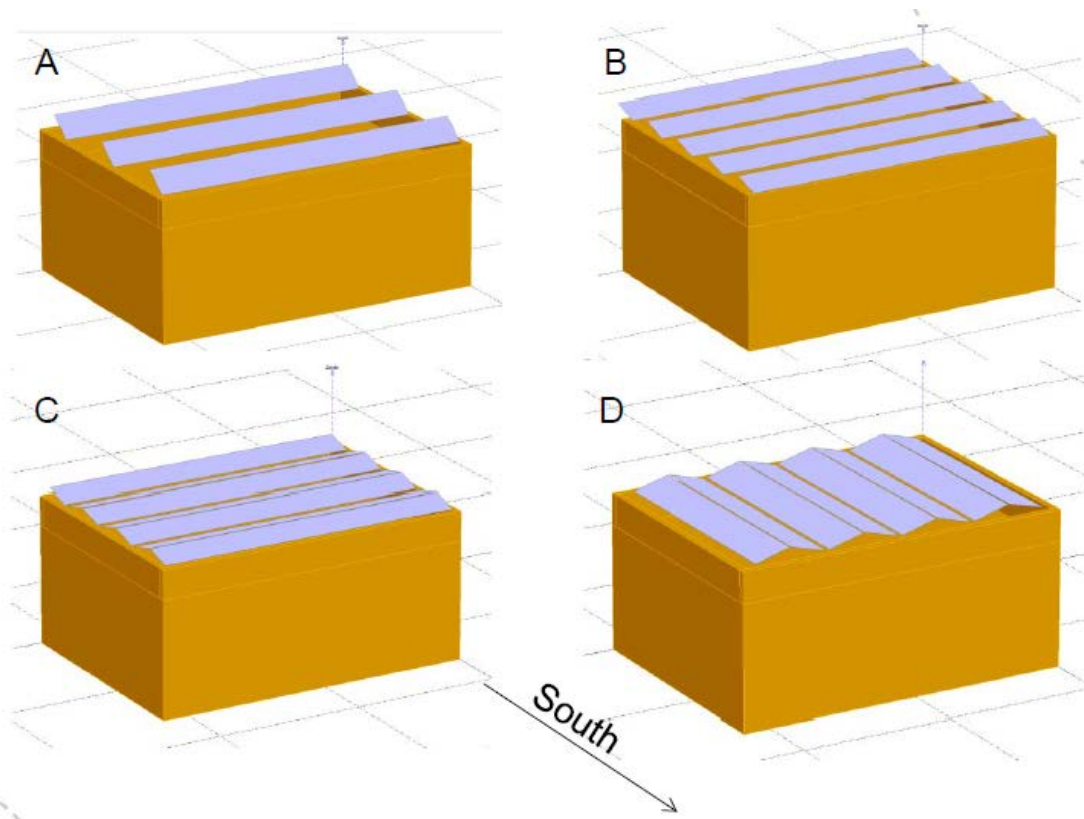
To zero with solar – comparison between PV, solar thermal and hybrid PV/T systems for a Norwegian zero energy building (Clara Good); Accepted for poster presentation at Eurosun 2014, Aix-les-bains

## Submitted:

Hybrid photovoltaic-thermal systems in buildings – a review with European and Asian perspectives (Clara Good, Jinfeng Chen, Yanjun Dai, Anne Grete Hestnes) Submitted to SHC conference 2014, Beijing

Evaluation of solar potential in Norwegian residential buildings types based on energy demand, building form and solar availability (Clara Good, Nicola Lolli, Anne Grete Hestnes) Submitted to SHC conference 2014, Beijing

# A comparative study of different PV installations for a Norwegian nZEB concept (Clara Good, Aoife Houlihan Wiberg, Torhildur Kristjansdottir, Laurent Georges)



So which PV system is «the best»? It depends...

- High output (size)
- High specific output
- Low embodied emissions
- High energy output per unit of embodied emissions

# PARAMETRIC DESIGN TOOL

Method Rhino, Grasshopper and Galapagos

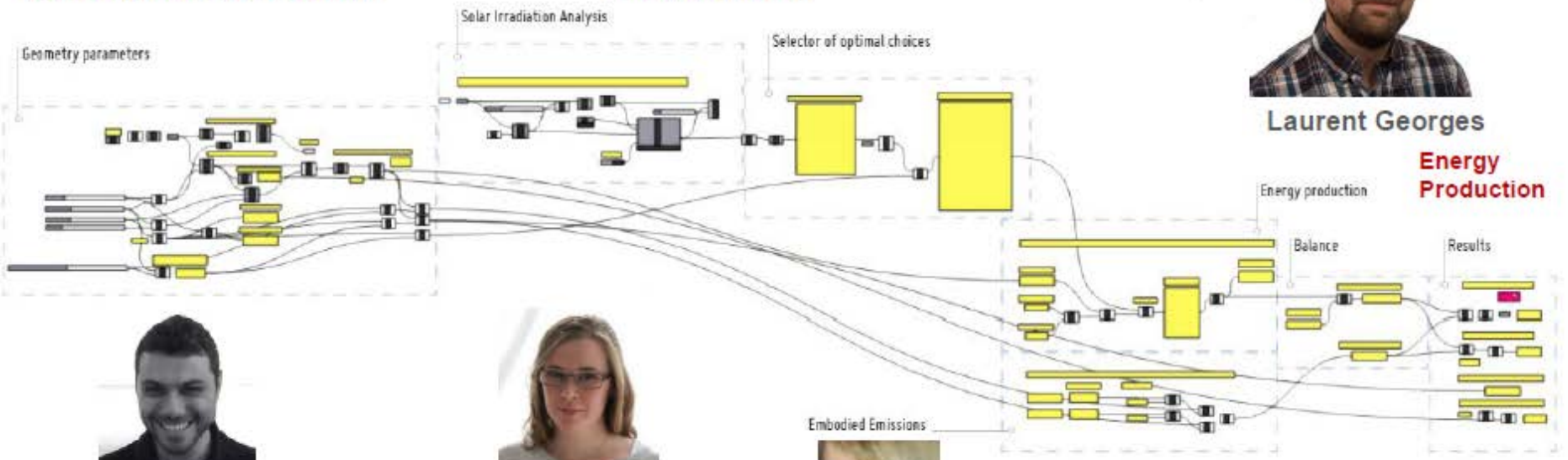
Architectural Design Decisions

Solar Availability



Laurent Georges

Energy Production



Gabriele Lobaccaro



Clara Good



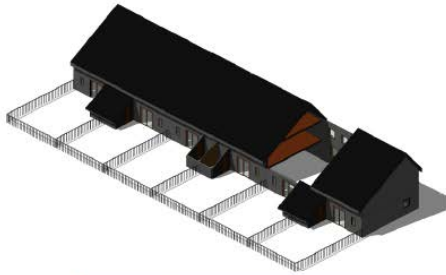
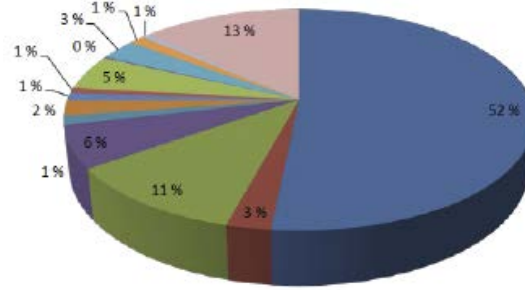
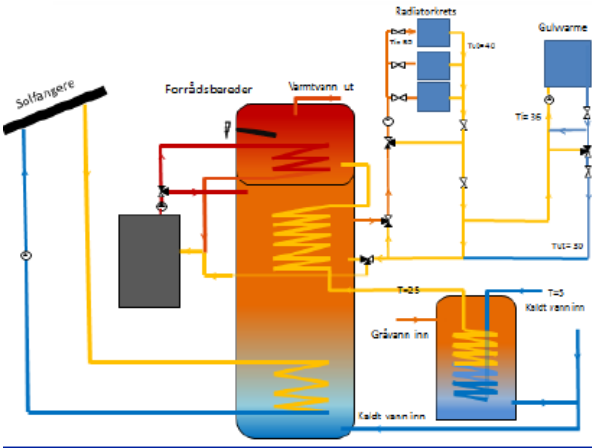
Embodied missions

Aoife Houlihan Wiberg

Fig. 19 - Complete view of Grasshopper Script



# Experts in Team Powerhouse (Rolf André BOHNE)



**NTNU**  
Innovation and Creativity

- Experts in Team group work
- Positive Energy Buildings:  
Building Design,  
Energy Systems,  
Solar Energy,  
Life Cycle Analysis

Input to Summer School 2015:

- 2 week group work
- Cooperation with industry

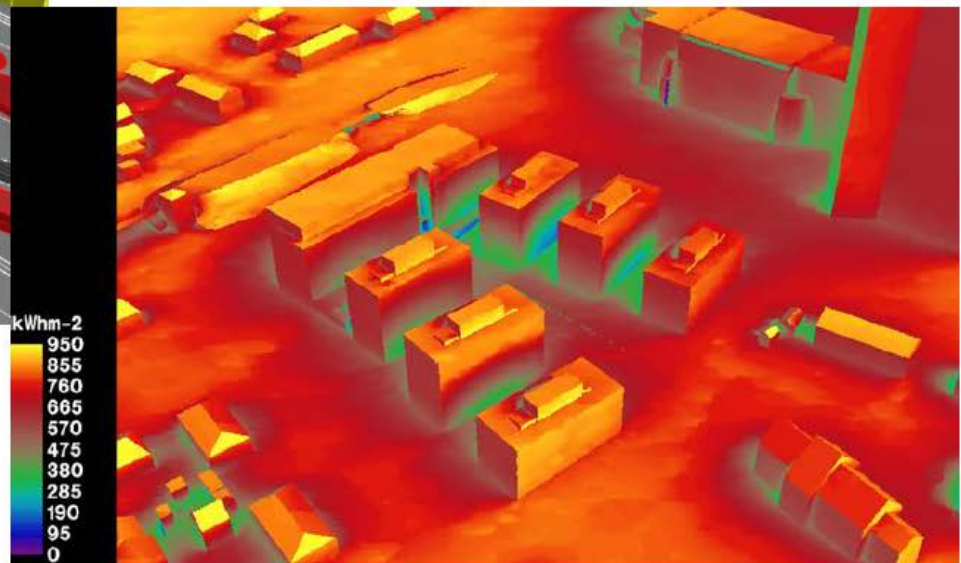
# Solar Energy in Urban Neighbourhoods (Gabriele LOBACCARO)

Joint Publication plans:  
Comparing Norwegian and Chinese conditions;  
Case studies in Shanghai? (IEA SHC Task 51)

Input to Summer School 2015:  
Solar energy in urban neighbourhoods;  
Simulation methods

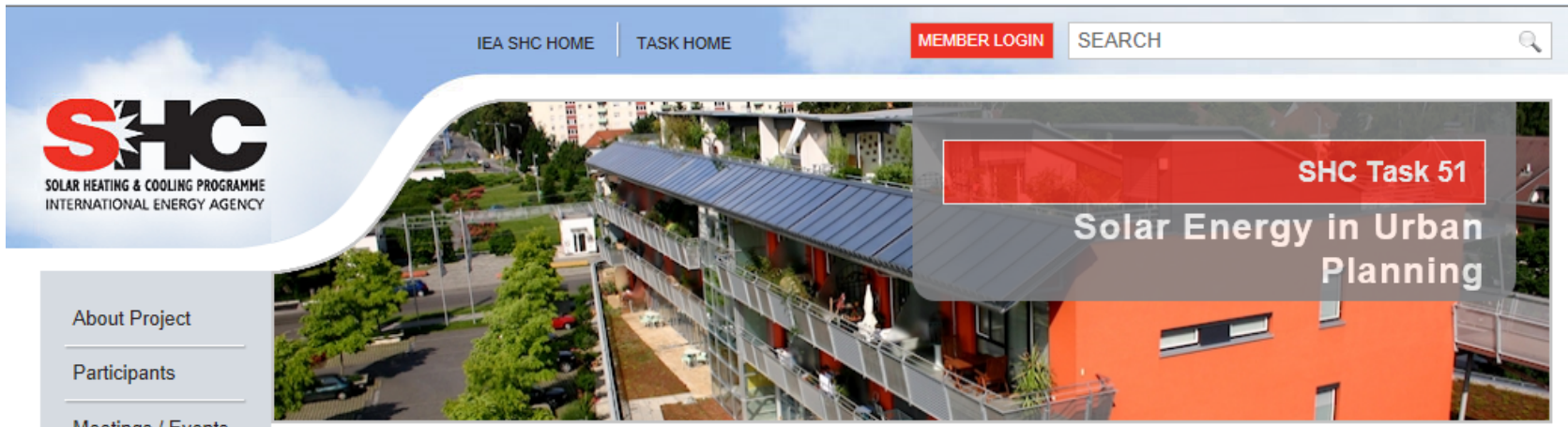
## Solar Radiation in Norway - Trondheim case study

### Solar Mapping Analysis - Context scenario (entire building envelope)



- **20%** of direct radiation
- **11.5%** of global radiation

# IEA SHC Task 51 Solar Energy in Urban Planning



- About Project
- Participants
- Meetings / Events
- News
- Publications
- Related Sites
- Member Area
- Contact

## Solar Energy in Urban Planning

A large portion of the potential for energy efficiency in existing buildings and potential to utilize solar energy still remains unused. Globally, goals and specific targets are set up to reduce our environmental impact on climate and secure future supply of energy. The built environment accounts for over 40% of the world's total primary energy use and 24% of greenhouse gas emissions. A combination of making buildings (refurbishing and new developments) more energy-efficient and using a larger fraction of renewable energy is therefore a key issue to reduce the non-renewable energy use and greenhouse gas emissions. Political statements and directives are already moving towards zero-energy buildings, communities and whole cities. An increased use of solar energy is one important part of the development ahead, where the urban fabric needs to utilize passive solar gains and daylight to reduce the energy use in buildings and for lighting outdoor environments, as well as to improve the inhabitants' comfort indoors and in urban outdoor areas. Also, active solar energy systems integrated in the urban context will enable a supply of renewable energy primarily as heat and electricity, but also of solar cooling, helping cities reach sustainable solutions.

### Task Information

**DURATION**  
mai 2013 — april 2017

**OPERATING AGENT**  
Maria Wall  
SWEDEN  
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[maria.wall@ebd.lth.se](mailto:maria.wall@ebd.lth.se)

### What's New

**NEWS**   **MEETINGS**   **PUBLICATIONS**

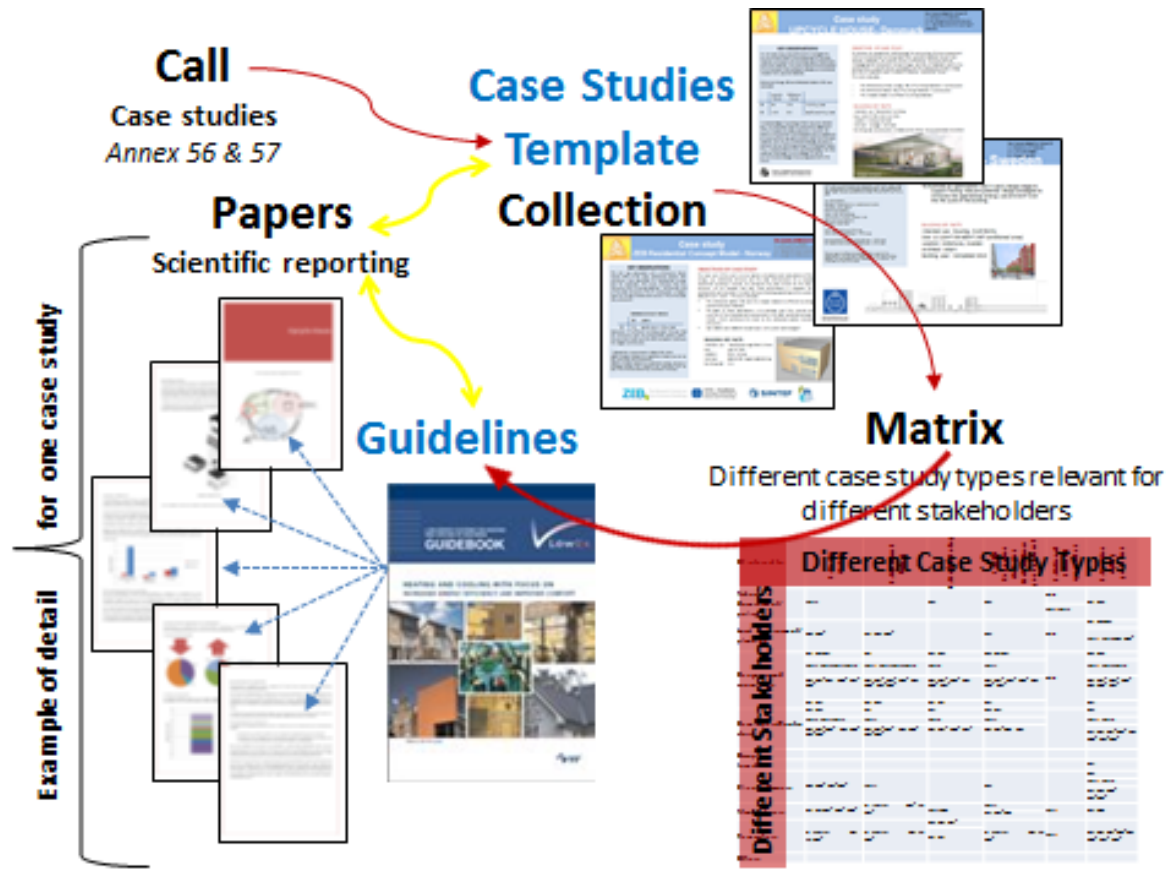
SHC 2014 is Now Open for the Submission of Abstracts - The SHC 2014 website is now live and open for the submission of abstracts — deadline May 30, 2014.

Shanghai as case study?  
Summer School?



# IEA Annex 57 Evaluation of Embodied Energy and Carbon Dioxide Emissions for Building Construction

This annex includes participants from over 20 countries worldwide and aims to provide stakeholders with detailed information, as well as, **guidelines on calculation methodologies, databases and methods for design and construction of buildings with low embodied energy (EE) and embodied greenhouse gases emissions (EC)**





# Solar Energy + Zero Emission Buildings + Urban Neighbourhoods

13-15 Oct 2014

IEA SHC Conference Beijing

Autumn 2014

Visit to SJTU: Clara GOOD (Oct-Dec), Arild GUSTAVSEN (1 day, Sept) and Annemie WYCKMANS (10 days, Nov-Dec)

Autumn 2014

Climate and Built Form Course NTNU

*Autumn 2014*

*Project application to Research Council Norway?*

Spring 2015

Jinfeng CHEN visits NTNU

20 March 2015

IEA SHC Task 51 meeting Trondheim  
Solar Energy in Urban Planning (NTNU)

Summer 2015

Summer School SJTU (*+ further developed into regular course on solar energy at SJTU*)

*Summer-Autumn 2015*

*Writing joint publications about Summer School*

Summer 2016

Summer School IEA SHC T51



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# **Double Degree Sustainable Energy Use in Buildings (Vojislav NOVAKOVIC)**

## **Basis:**

**Master degree in Mechanical Engineering from SJTU and NTNU  
(Responsible: Prof. NOVAKOVIC)**

## **Connected:**

**Civil Engineering / Zero Emission buildings  
(Responsible: Assoc. Prof. Rolf André BOHNE)**

## **Connected:**

**Sustainable Architecture / Zero Emission Buildings  
(Responsible: Assoc. Prof. Luca FINOCCHIARO)**

# Double Degree Sustainable Energy Use in Buildings (Vojislav NOVAKOVIC)

- 27 June 2014** Education meeting in Energy in Buildings group + SJTU-NTNU Education Meeting to discuss Double Degree
- Week 24, 2014** Professor H.M.Mathisen and researcher M.J.Alonso to visit GEL at SJTU
- Autumn 2014** Registration of the DD to study administration at NTNU and SJTU, marketing to potential students
- Autumn 2014** Student Mech Eng to GEL-SJTU: Ludvig Nielsen
- September 2014** Possible coordination meeting regarding Civil Eng and Sust Arch at SJTU? (incl NTNU responsables)
- Spring 2015** Professor V.Novakovic sabbatical at GEL-SJTU  
Student Mech Eng to GEL-SJTU: Marte Wigen Nilsson
- Autumn 2015** Start of DD for Mech Eng and if possible for Civil Eng and Sust Arch

# Link to MSc in Sustainable Architecture / Zero Emission Buildings? (Luca FINOCCHIARO)

**MSc in Sustainable Architecture**  
towards a zero emission built environment

I semester



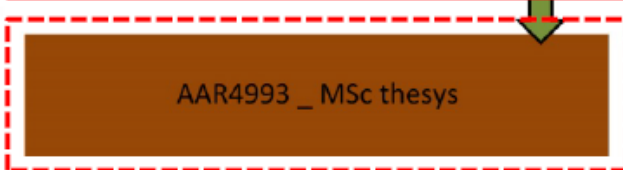
II semester



III semester



IV semester



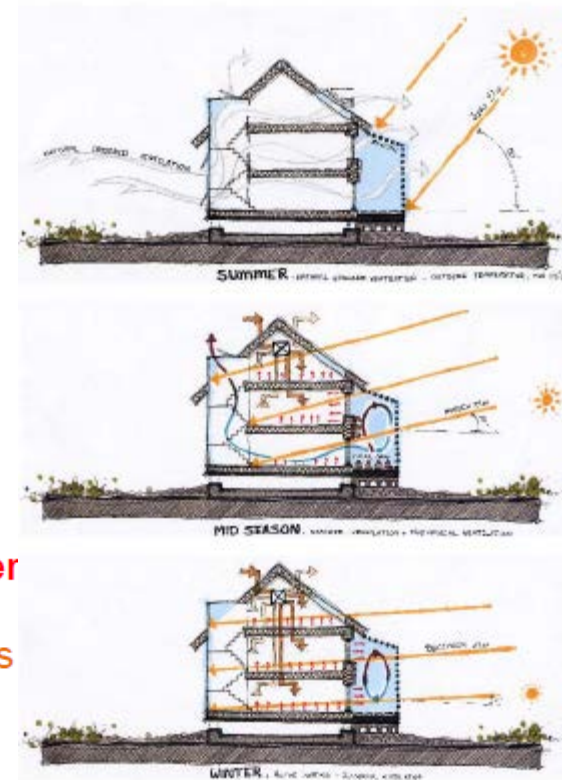
SJTU >>> NTNU  
Teachers exchange



MSc Sustainable Energy in Buildings **Key semester**



MSc Collaborative thesis  
SJTU / NTNU



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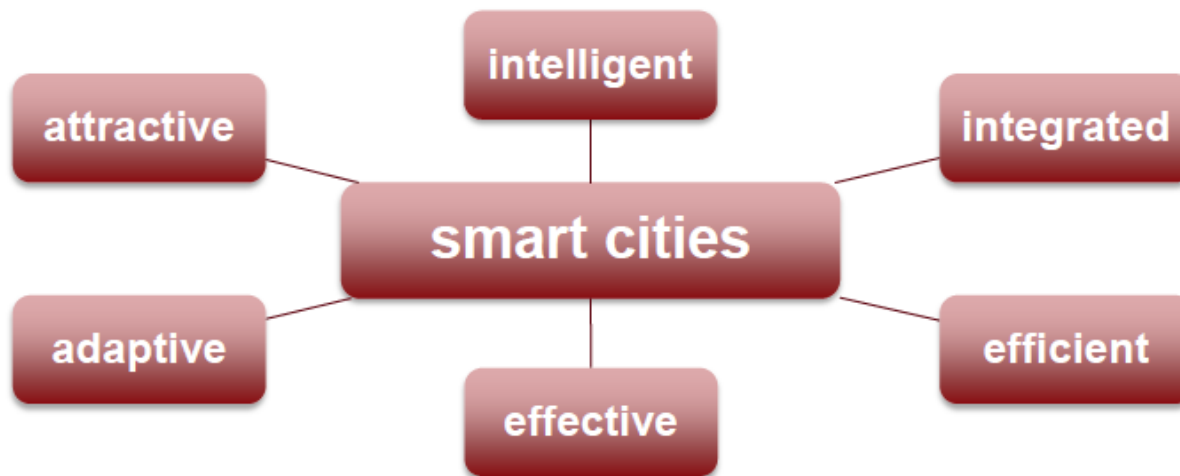


# EERA Joint Programme Smart Cities



## Smart Cities – the targets

- Dramatic reduction of **CO<sub>2</sub> Emissions**
  - Maximise **energy efficiency**, minimise use of resources
  - Maximise integration of **renewable energy sources**
  - **Urban energy management** at city level
- Boosting economy and strengthening the competitiveness of cities
- Increase quality of living and wealth



# EERA Joint Programme Smart Cities



## Current dialogue with China

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- Framework of EU-China Urbanisation Partnership
  - Chinese partners in process: NDRC, relevant ministries (MOST, MOHURD), city authorities, research + academia, developers, industry
  - JP Smart Cities as strategic partner for EC providing thematic + policy input
  - Aiming at initiating common projects between EU and China (highly visible flagship projects)
  - Ideally alignment of research programmes (e.g. Horizon 2020)
  - Set-up of dedicated working groups and joint roadmaps
- EU-China Mayors' Forum, Brussels, September 2012
  - JP Smart Cities co-organiser of side-event on „Research for Sustainable Urbanisation“
- EU-China Innovation Seminar, Beijing, November 2013
  - Active involvement of JP Smart Cities in „Energy Session“ for urban development
- Principal questions under discussion:
  - What are the current common challenges and barriers?
  - What could be the joint objectives/goals for such co-operations?
  - What are best-practice examples?
  - Which are the key topics to be tackled jointly?
  - What kind of instruments do we need to foster bilateral cooperations?



# ERA-NET Co-Fund Smart Cities & Communities

Programme application submitted  
7 May 2014,  
results expected in October 2014

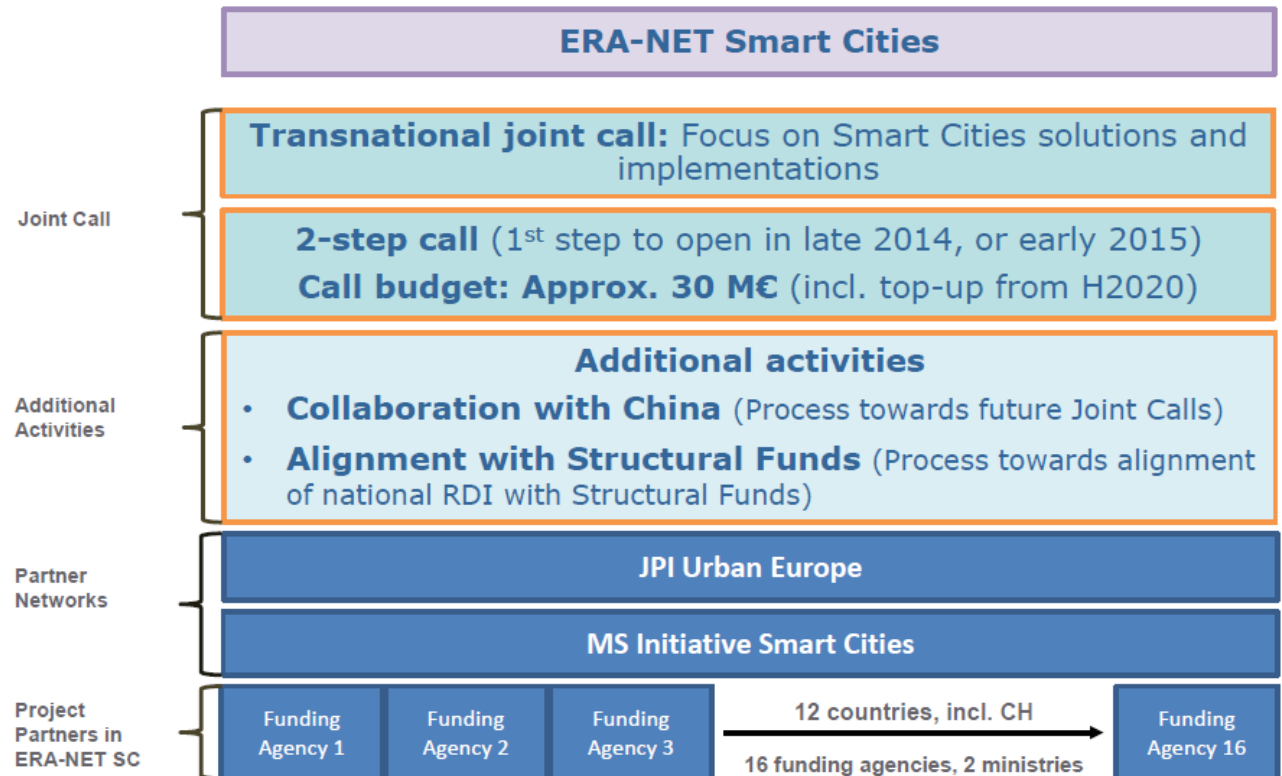
Potential themes of Joint Call:

1. Smart urban energy and mobility systems
2. Smart tools and services for integrated urban energy and transport systems
3. Smart data, big data
4. Smart governance and smart citizens



Smart Cities  
Member States Initiative

## Structure of the ERA-NET Smart Cities



# Summer School SJTU – NTNU 2015

## Smart Sustainable Cities and Communities

The Summer School will allow students to gain a cross-cultural and interdisciplinary perspective on sustainable energy, in particular on smart sustainable cities

Asian and Nordic perspectives on the potential role of buildings, solar energy, refrigeration, energy systems and services, etc

To contribute to smarter, energy-efficient, sustainable cities with high quality of life, using Shanghai as a case

- Horizontal cooperation across all SJTU-NTNU Sustainable Energy groups
- Links to strategic development of EU – China cooperation (incl Norway)
- Inclusion of other schools
- Chinese funding related to Sustainable Development