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The IEA ECBCS Programme

Yi Jiang,
Building Energy Research Centre
Tsinghua University

,
Beijing 27 November 2012

ECBCS - the Implementing Agreement on "Energy Conservation in Buildings and Community Systems"

- International Collaborative Agreement
- Energy Research, Development, Demonstration and Dissemination
- 26 Member Countries
- Open Innovation approach

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General Agreements in Building field

- Energy Conservation in Building & Community Systems
- Heat Pumps
- Solar Heating & Cooling
- Thermal Storage
- District Heating & Cooling

The ECBCS Programme

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R&D Projects

Knowledge Deployment and Demonstration

R&D Strategies

Buildings

Communities

26 Participating Countries

- Australia
- Austria
- Belgium
- Canada
- P.R. China(2009)
- Czech Republic
- Denmark
- Finland
- France
- Germany
- Greece
- Ireland (2010)
- Italy
- Japan
- Republic of Korea
- Netherlands
- New Zealand
- Norway
- Poland
- Portugal
- Spain
- Sweden
- Switzerland
- Turkey (2011)
- UK
- USA

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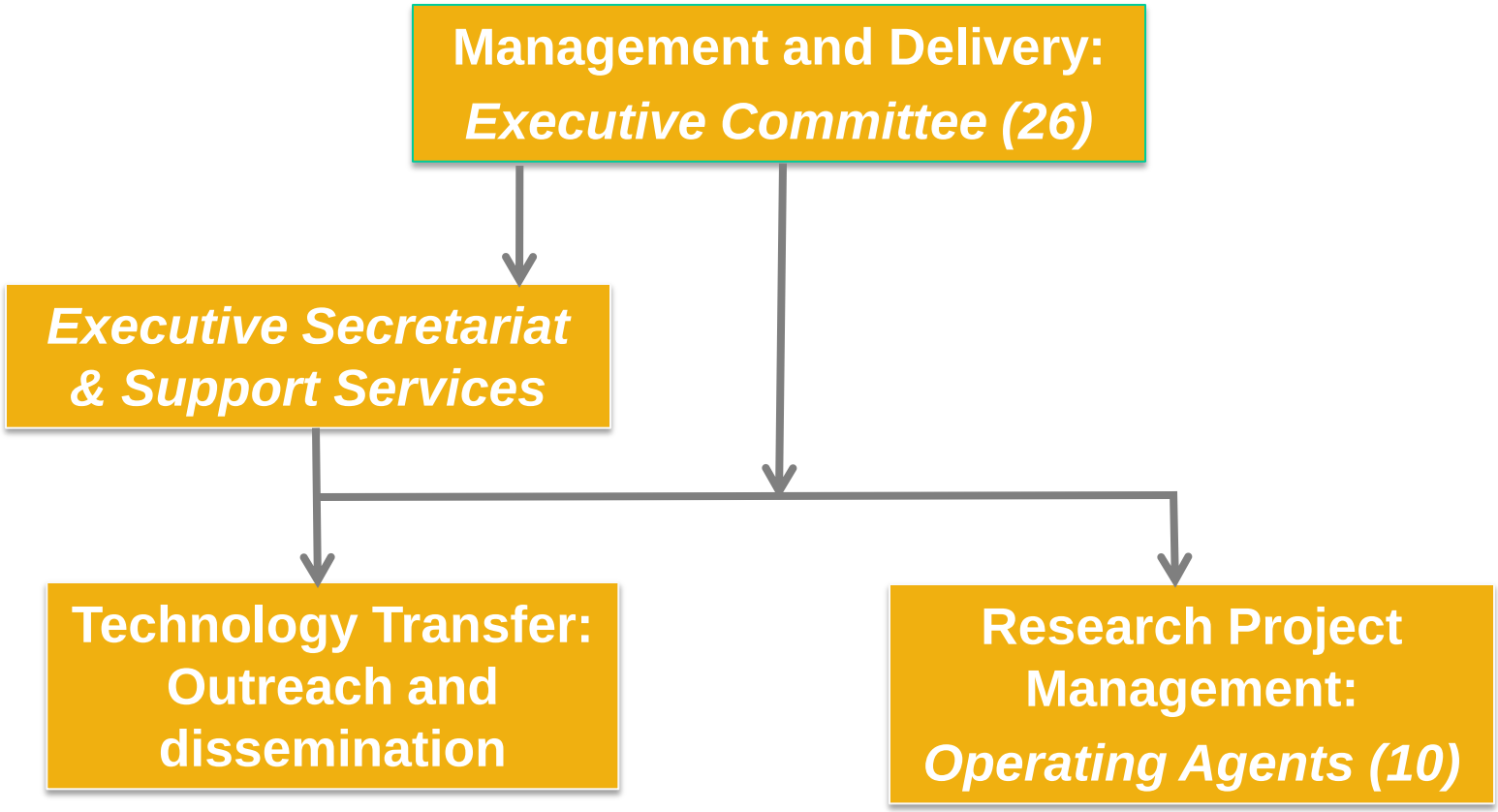
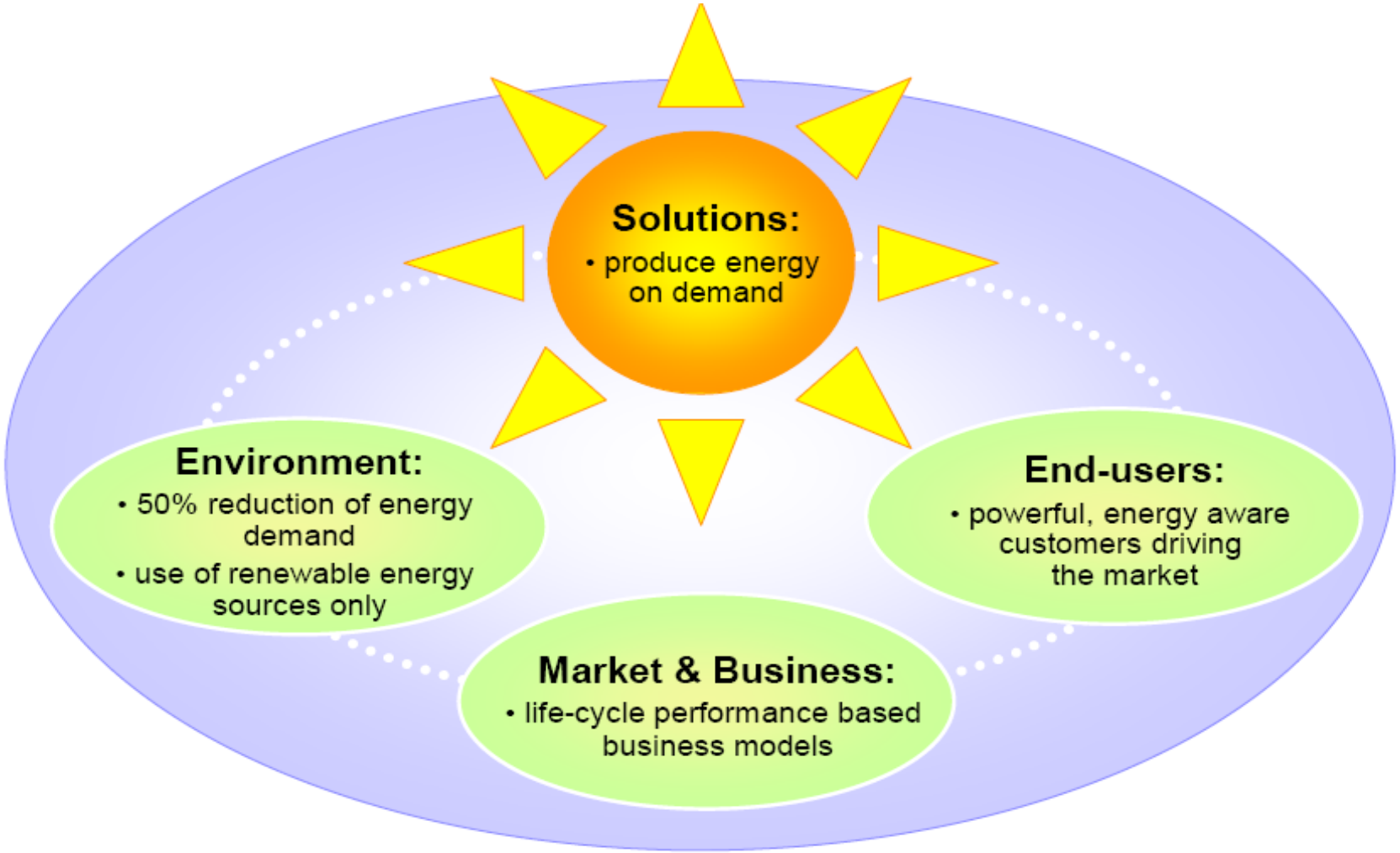
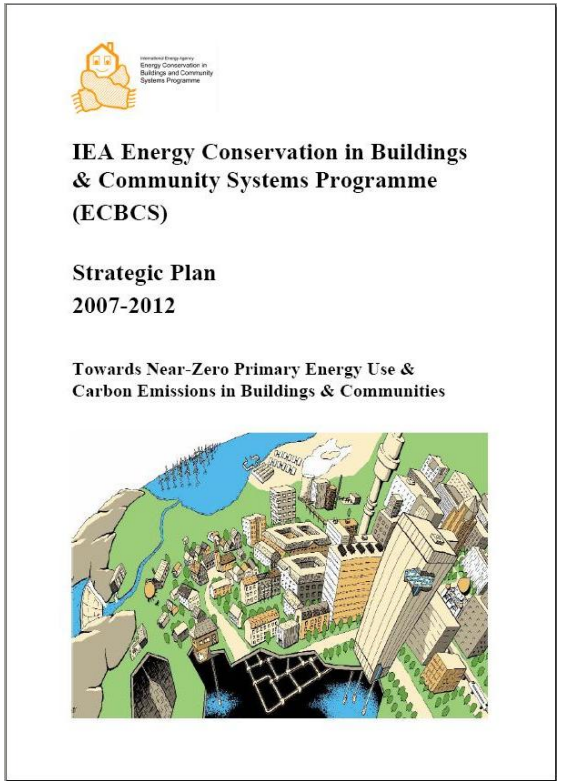
Programme Governance



Vision for the Built Environment:
Adoption of nearly-zero primary energy use and CO2 emissions solutions



ECBCS Mission



… to facilitate and accelerate the introduction of **energy conservation** and **environmentally sustainable technologies** into healthy buildings and community systems…

- From incremental to radical decrease of energy
- “Clean” energy
- “Smart” energy regulations

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The Sector: Buildings & Communities

Energy = 30% – 40%

CO2 emissions = +30%

Solid Waste = 25% – 40%

Primary Resources = +50%

GDP = 10% – 15%

Fragmented sector

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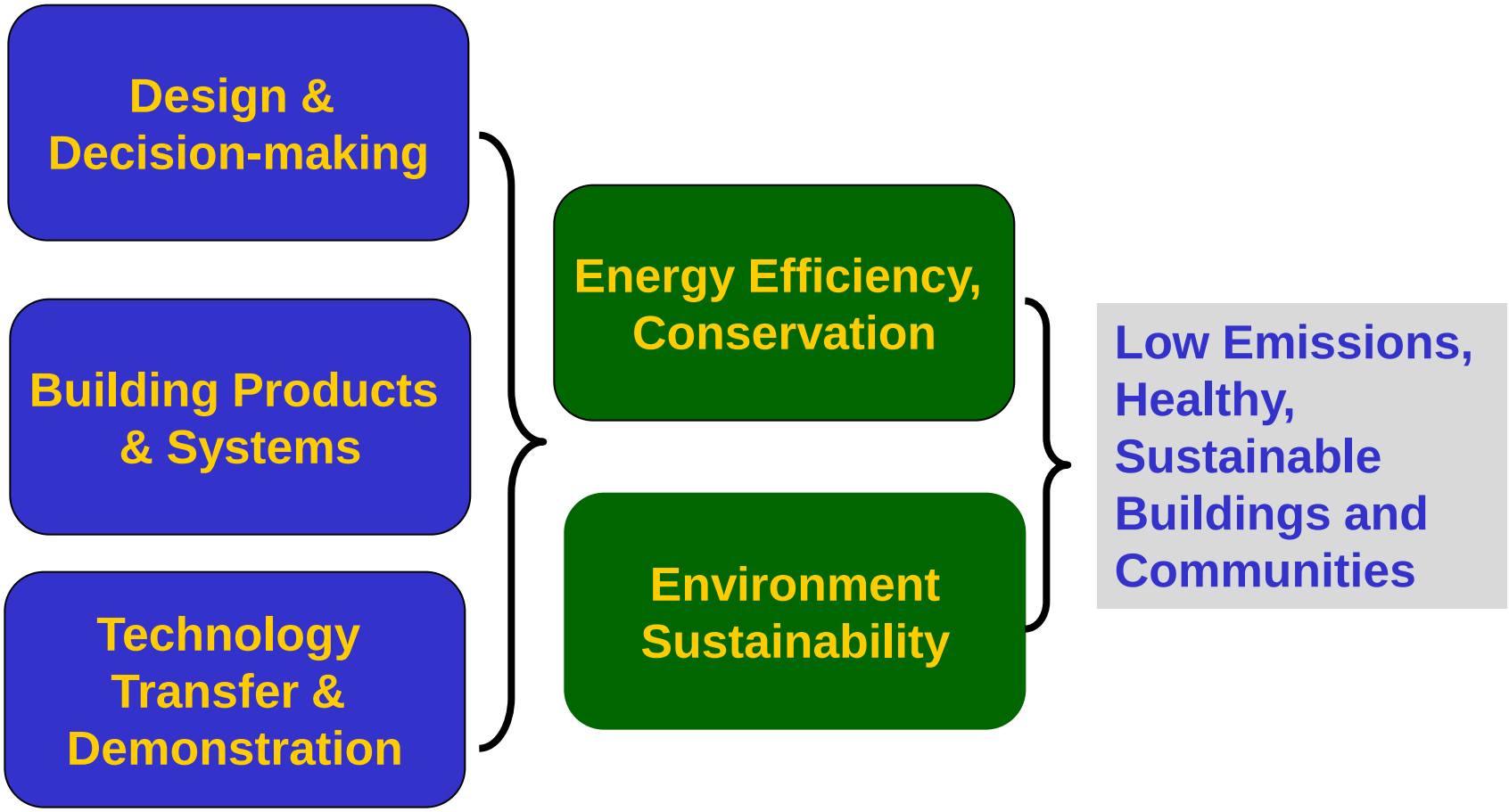
Outputs & Outcomes



Value Chain in Construction Market

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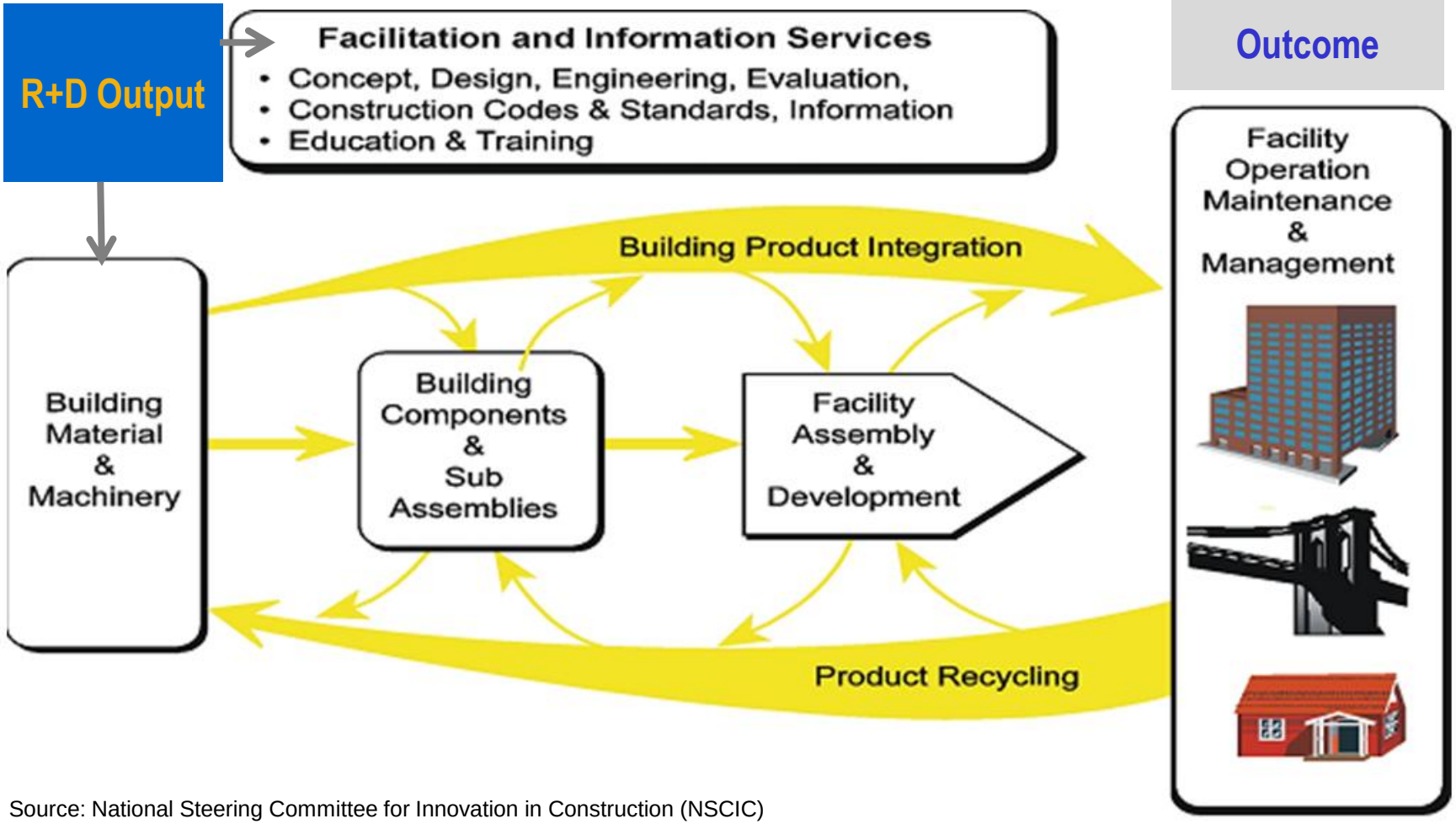

Source: National Steering Committee for Innovation in Construction (NSCIC)

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Scope of Innovation in ECBCS: Technology Readiness Levels

Level	Description
1	Transfer of scientific research to applied R&D
2	Identification and/ or evaluation of possible applications of the technology
3	First level of Proof of Concept
4	Bench scale study of the technology as a whole.
5	Bench scale study of integrated system in simulated application.
6	Scale up of technology and testing in simulated application.
7	Demonstration -Full scale demonstration of technology in industry setting.
8	Business- Release for commercial implementation
9	Business- Further improvements implemented

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Focus Areas

1. Building Concepts and Methodologies
2. Integrated Building Systems
3. Building Services
4. Building Benchmarking & Measurements
5. Integrated Community Systems

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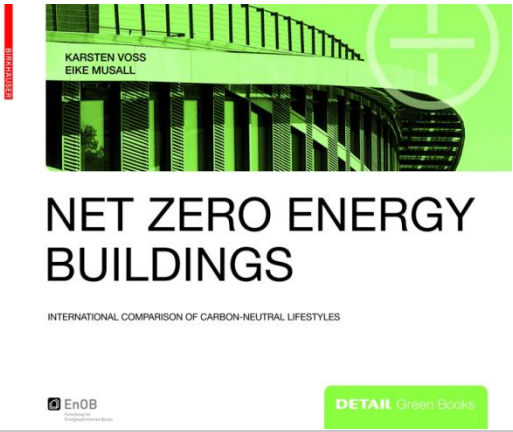
1. Building Concepts and Methodologies

- Development & Demonstration of Financial & Technical Concepts for Deep Energy Retrofits of Public Buildings & Building Clusters (Annex 61)
- Cost effective Energy and CO_2 Optimization in Building Renovation (Annex 56)
- Towards Net Zero Energy Solar Buildings (Annex 52)



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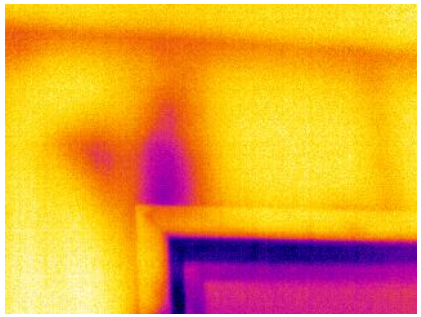
2. Integrated Building Systems

- Reliability of Energy Efficient Building Retrofitting - Probability Assessment of Performance & Cost (Annex 55)
- Prefabricated energy retrofit systems for residential buildings (Annex 50)



3. Building Services

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- New Generation Computational Tools for Building & Community Energy Systems Based on Modelica (Annex 60)
- High Temperature Cooling & Low Temperature Heating in Buildings (Annex 59)
- Integration of Micro-generation & Other Energy Technologies in Buildings (Annex 54)

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4. Building Benchmarking & Measurements

- Reliable Building Energy Performance Characterisation Based on Full Scale Dynamic Measurements (Annex 58)
- Evaluation of Embodied Energy & CO2 Emissions for Building Construction (Annex 57)
- Total Energy Use in Buildings: Analysis & Evaluation Methods (Annex 53)

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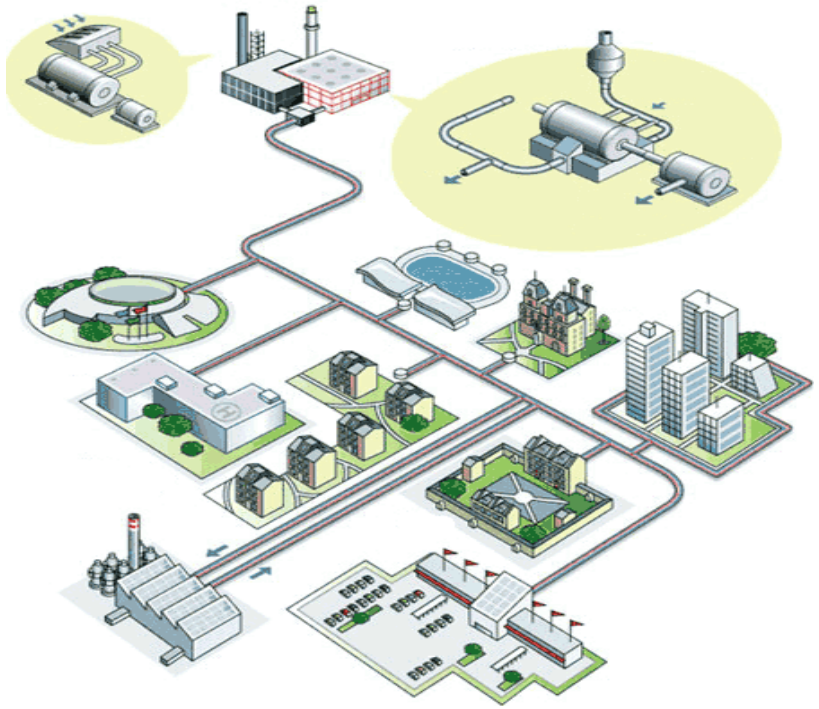
5. Integrated Community Systems

- Guidelines and Case Studies for Energy-Efficient Communities (Annex 51)
- Low-Exergy Systems for High Performance Buildings / Communities (Annex 49)



Annex 53: Total building use in buildings: analysis & evaluation method

- Proposal approved in 2008
- ~20 institutions from 12 countries participated: Austria, Belgium, Canada, China, Denmark, Finland, Italy, Japan, Netherlands, Norway, Spain, USA
- 1 year preparation and 3 years working
- 8 work meetings during 4 years
- 10 forums or symposiums to dissemination

Annex 53: Total energy use in buildings: analysis & evaluation methods

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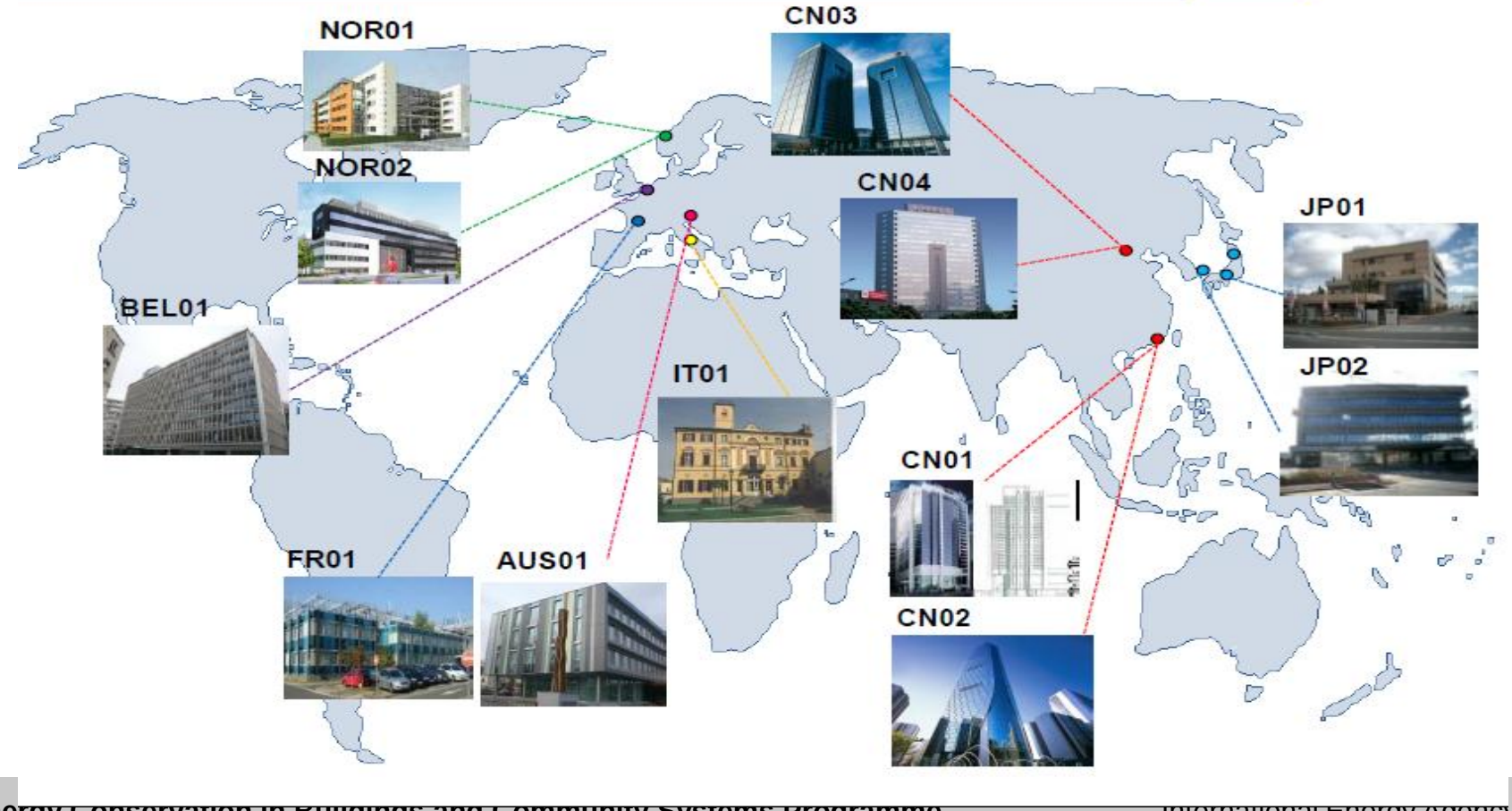
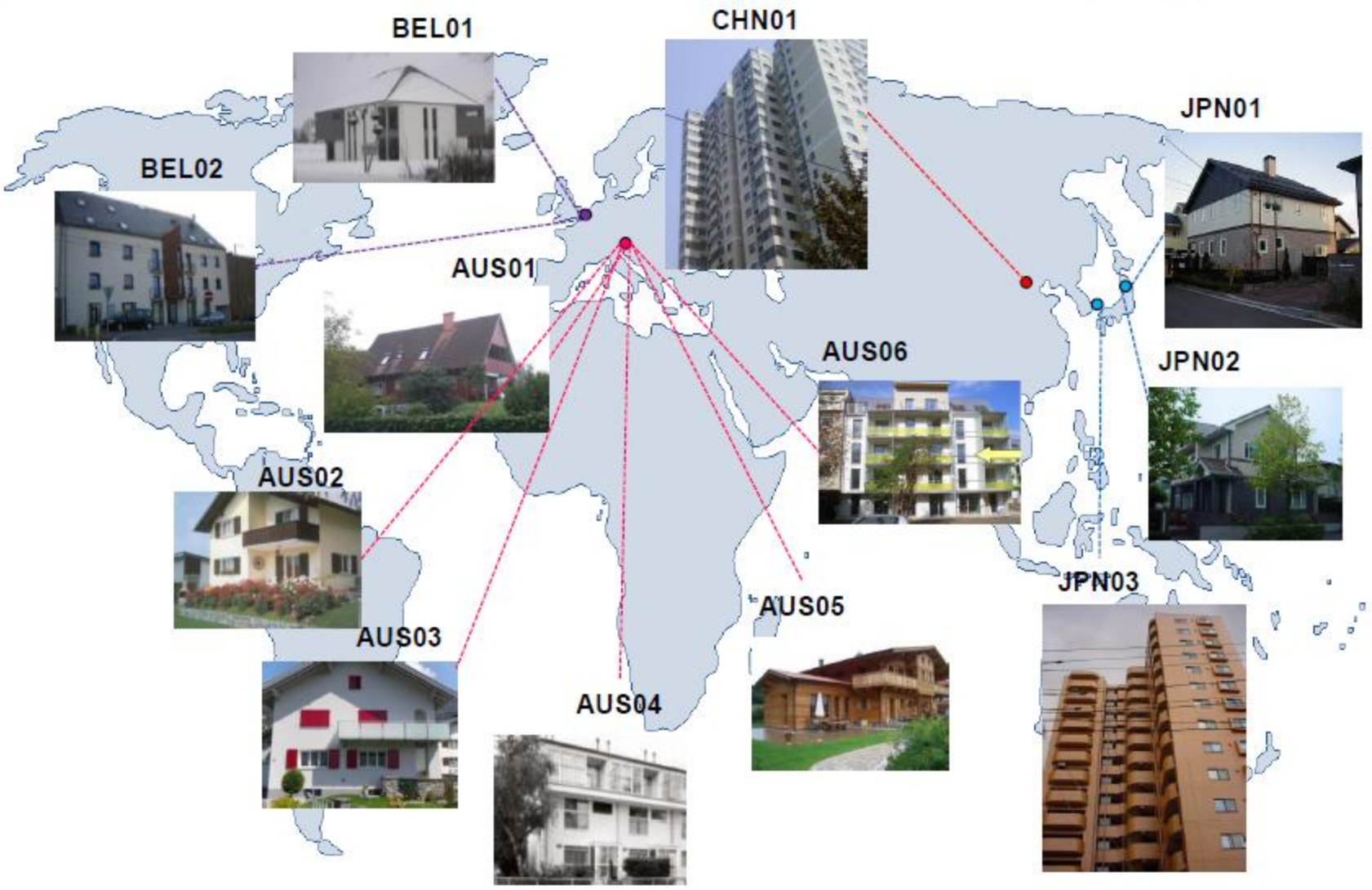
Available Cases-12 Office Buildings



Available Cases-12 Residential Buildings



Annex 53: Total energy use in buildings: Analysis & evaluation

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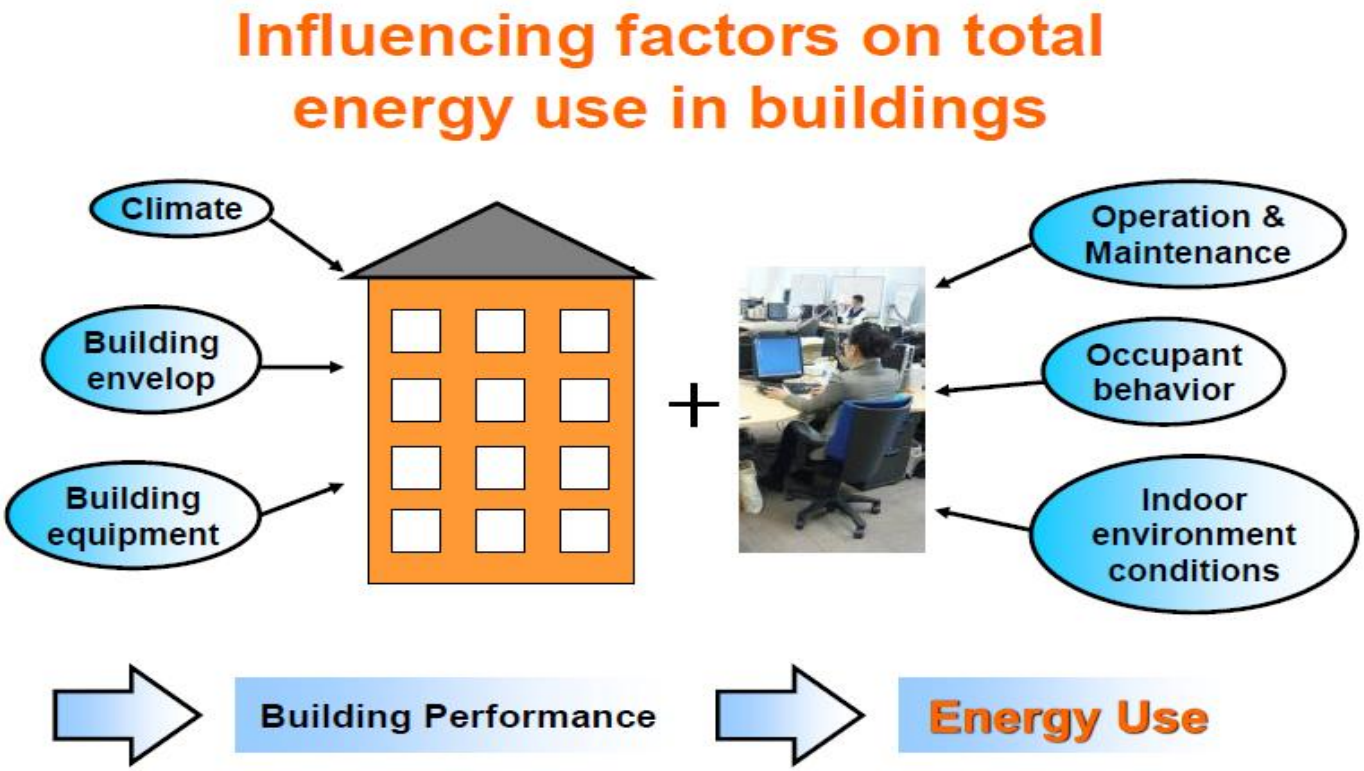
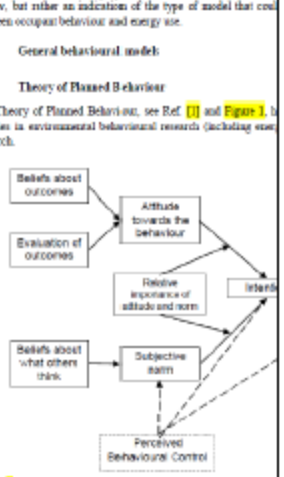


Draft Report of Task Force: Modeling of occupant behavior

Total energy use in residential buildings – the modelling of occupant behaviour



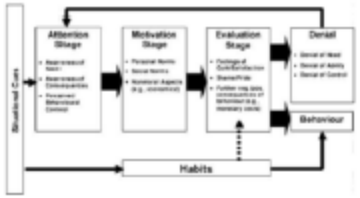


Figure 4: Relative electrical energy consumption day-profiles for "not workdays" divided into four seasons. See Ref. [23].

These profiles can be implemented in various dynamic simulation programs for simulation of energy consumption but equal important also for simulation of indoor environment. By use of the profiles it is possible to conduct more accurate simulations of e.g. the indoor environment and thereby get more accurate results regarding both thermal comfort and indoor air quality.

Stochastic models:
Cooking is one of the domestic activities that have been modelled stochastically in Ref. [31]. This model produces activity patterns for individual occupants as well as the domestic electricity demand based on these patterns. The activity patterns are based on a nine-state (absence, sleeping, cooking, dishwashing, washing, TV, computer, audio, other) Markov chain. The Markov chain transition probabilities are based on extensive Swedish measurements between 2001 and 2007 in monthly or annual periods in 14 households and time-use data for five of these households. Based on these transition probabilities, at each time step in the calculation a stochastic process determines which activity will take place. Using a relatively simple conversion model, generalised load patterns for various electricity end-uses are related to the activities in order to calculate the power demand for the end-uses.

3.3.4 Probabilistic models for lighting control (the Lightswitch model)

Type of behaviour	Type of model	Statistics used	Implemented into computer simulation (software)	Validated	Reference
Lighting	Probabilistic	Markov model	Yes (?)	Yes (?)	[34]

Current Situation of Building Energy

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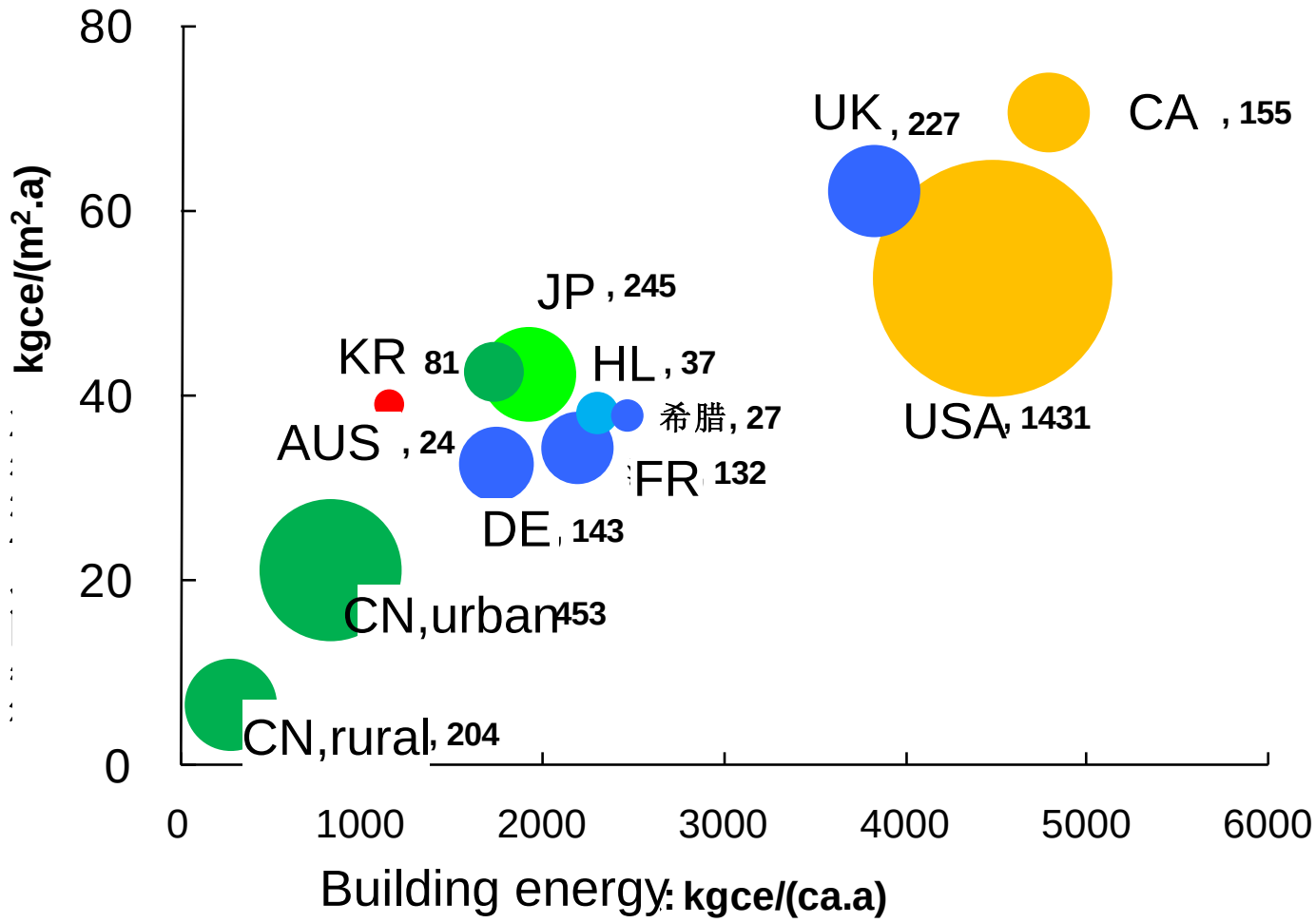

Energy use and service level

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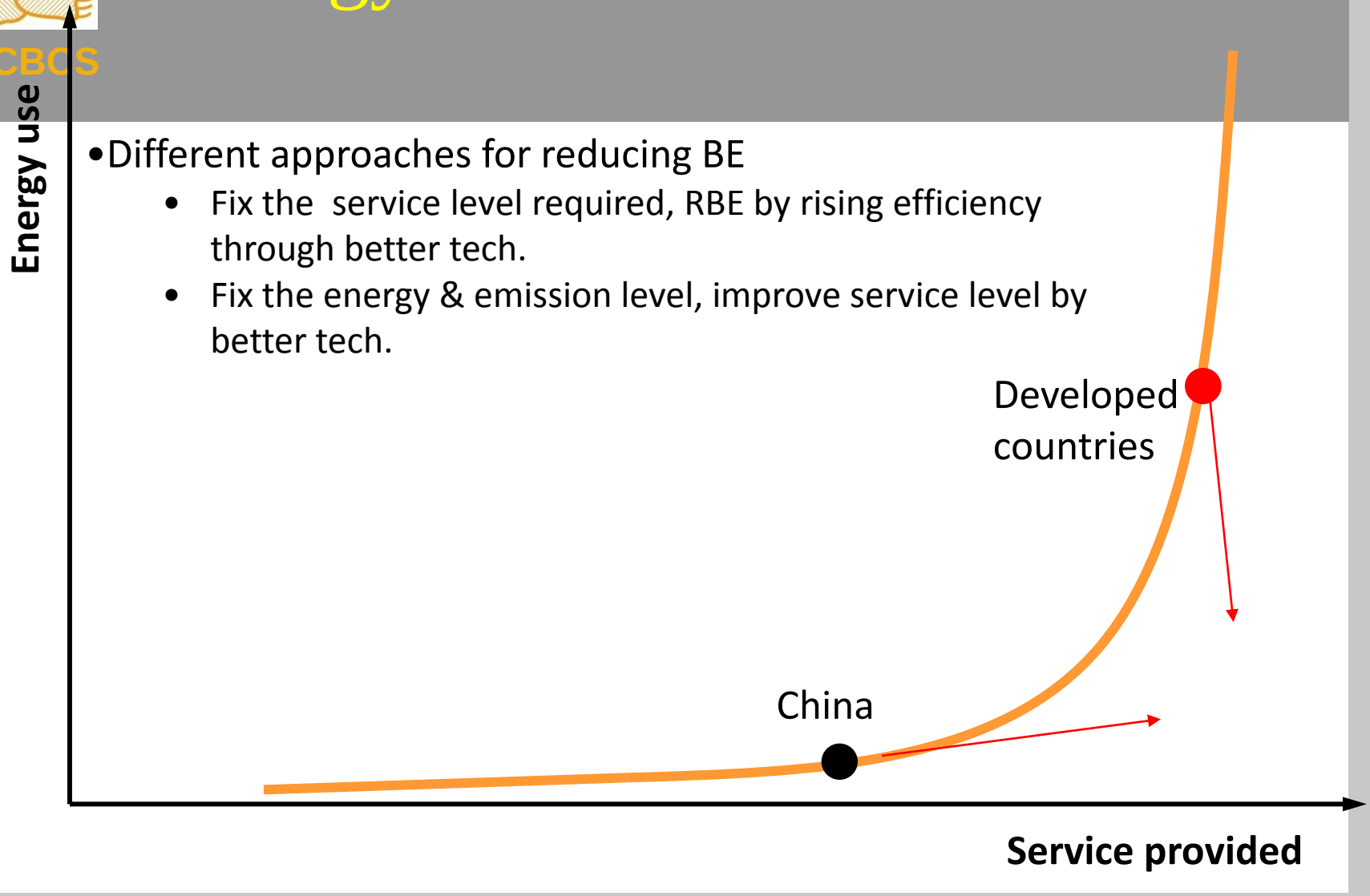
- Different approaches for reducing BE
  - Fix the service level required, RBE by rising efficiency through better tech.
  - Fix the energy & emission level, improve service level by better tech.



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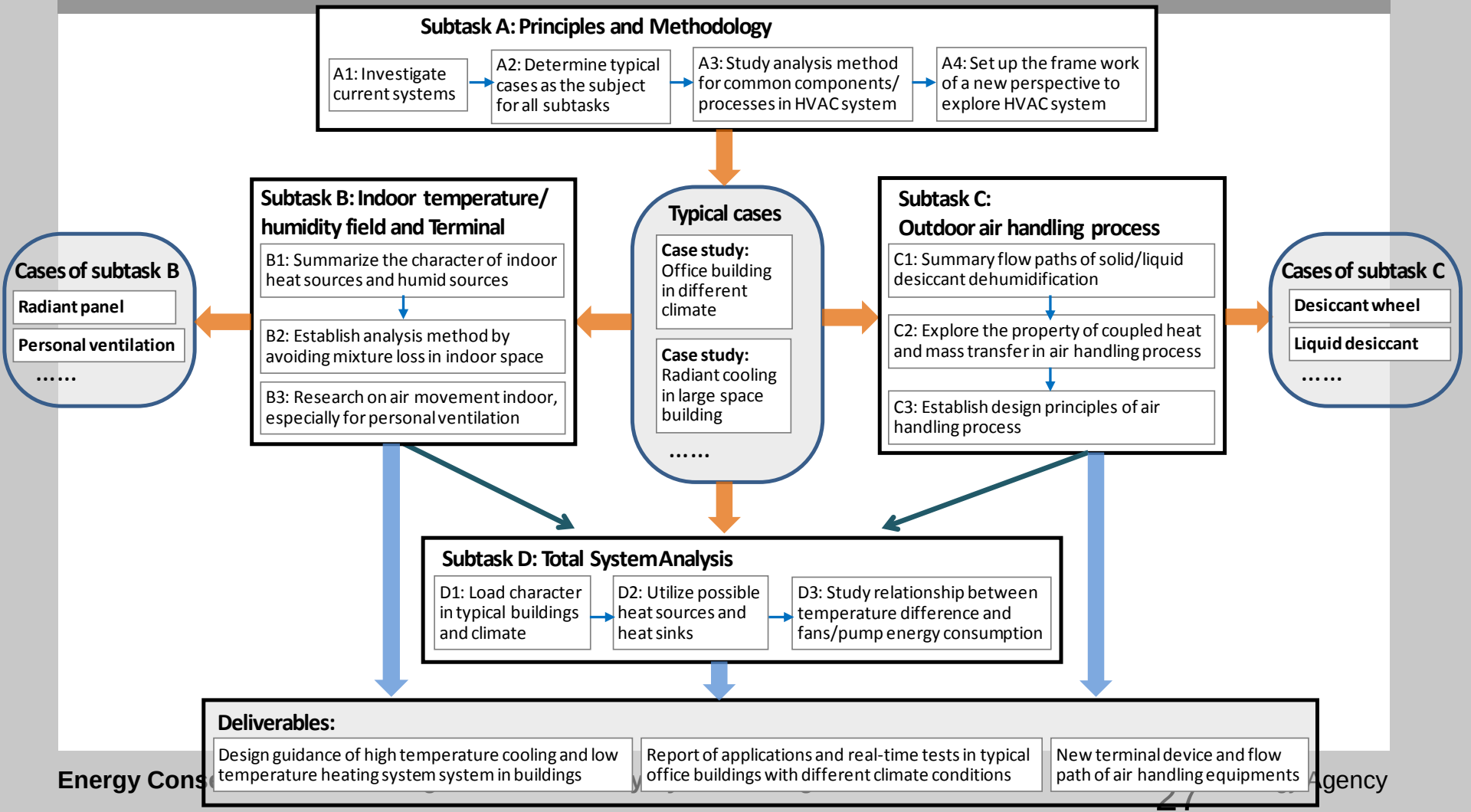
On going project: Annex 59

- High temperature cooling & low temperature heating in buildings
- Operation agency: China
- Participants: Belgium, China, Denmark, Finland, Italy, Japan, USA
  - Universities + Institutes + Industries
- Target:
  - New type of HVAC system to reduce 30% or more energy with better indoor service

Flow chart of Annex 59

IEA ECBCS ANNEX 59:

High Temperature Cooling & Low Temperature Heating in Buildings



Case studies in Annex 59

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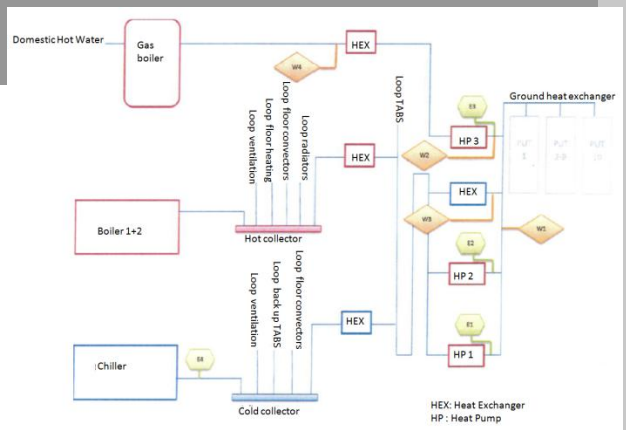
Case Study Building 1:
Bayer Diegem

> Location: Diegem, Belgium;
> Year of construction: 2009;
> Gross Floor area: 12,930 m²;
> Occupation: 220 occupants;
> Activities: Offices (Main), Meeting rooms, Restaurant, IT room, Underground parking



Case Study Building 2:
Xi'an Airport T3 Terminal

> Area: 258,000m², with a maximum height of 36.5m
> Coming into service since May 2012
> The first terminal adopting radiant cooling in China
> Temperature and Humidity Independent control system
> Humidity: liquid desiccant outdoor air processor; Temperature: radiant floor + dried FCU with high temprature chilled water

Dissemination & Outreach - Projects

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Project Results

- Full Scientific Reports
- Summary Reports
- Factsheets
- Tools

Dissemination & Outreach

www.ecbcs.org

- ECBCS Bookshop and website
- Conferences / seminars
- Demonstration

Dissemination & Outreach

- 2 Million down-loads per year
- 49 completed projects
- 3 new projects under development
- 12 current projects

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Recently Approved Projects

- Annex 59: High Temperature Cooling & Low Temperature heating of HVAC Systems
- Annex 60: New Generation Computational Tools for Building & Community Energy Systems Based on the Modelica & Functional Mockup Unit Standards
- Annex 61: Development & Demonstration of Financial & Technical Concepts for Deep Energy Retrofits of Government / Public Buildings & Building Clusters

Further Information

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Thank you