Resource- and Cost-effective integration of renewables in existing high-rise buildings

EU-project „Cost-Effective“

Coordinator: Fraunhofer ISE, Germany

Start date: 01/10/2008
End date: 30/09/2012
Duration: 4 years
Budget: 10'726'412 Euro
EC contribution: 7'492'344 Euro
Initial position

40% of the CO₂-emissions in EU25 are caused by buildings

- the use of renewables has to be increased, especially in large non-residential buildings

- net-zero energy buildings are the target
Initial position

small roof area

- the façade has to be used for energy conversion in addition to the roof.
Large non-residential buildings

- economic challenges
  - owner / facility manager / user
  - often short payback times expected
  → we need „integrated concepts“!

- innovations in the construction sector needed
  - high-risk low-margin market
  - European companies contribute to global “renovation boom” (CO₂ ▼ employment ▲)
  → we need European research projects!
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vision

converting facades of existing high-rise buildings into energy gaining components

Torre de Cristal Madrid
Source: Emmer Pfenninger Partner
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**Project Lifetime 4 years**
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WP1: State of the art analysis and problem identification

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Project Lifetime 4 years
Objectives WP1

- analysis of EU25 (and US and China)
  - current status
  - problems & opportunities
    (statistics and user assessments)
- analysis of state of the art technologies
WP1 is completed

Example:
analysis of energy consumption for space heating
- no strong trend because of adapted insulation standards

\[ \text{Average heating energy consumption} \ [\text{kWh/m}^2\text{a}] \]

Heating degree days [K*d/a]

responsible: Universities of Athens and Stuttgart
WP1: State of the art analysis and problem identification

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Project Lifetime 4 years
Objectives WP2

- building categories EU25
  - identification of 5 most important categories
  - representative buildings per category
  - performance criteria and targets

- technical concepts for renovation
  - using new components from WP3
  - using only existing components

refurbishment project Deutsche Bank, Frankfurt (Main), Germany (2008-2010)
source: ING. BÜRO P. BERCHTOLD
WP2: Five most important categories identified

cat. 1
- Post-war 1945-1965, massive facade in reinforced concrete structure

representative building
Petten, NL

responsible: ECN and KOW architects
WP2: Five most important categories identified

**cat. 2**

- 1960-1980 Reinforced concrete with perforated façade

*representative building*
*Vlaardingen, NL*

*responsible: ECN and KOW architects*
WP2: Five most important categories identified

representative building: Kreuzbauten Bonn, D

cat. 3

- 1975-1990 Skeleton construction with precast concrete

responsible: ECN and KOW architects
WP2: Five most important categories identified

representative building
Deutsche Bank HQ
Frankfurt (Main), D

1975-1995 Skeleton construction with curtain-wall facade

cat. 4

responsible: ECN and KOW architects
WP2: Five most important categories identified

representative building: tour EDF, Puteaux France

cat. 5

- Tall buildings,
  Skeleton construction with curtain-wall all-g glazed façade
  (1980-2005)

responsible: ECN and KOW architects
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WP3: Development of 5 new multifunctional components

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Project Lifetime 4 years
Objectives WP3

- develop 5 new façade components
  - transparent solar thermal collector for glazing integration
Objectives WP3

- develop 5 new façade components
  - transparent solar thermal collector for glazing integration
  - air-heating vacuum tube collector
Objectives WP3

- develop 5 new façade components
  - transparent solar thermal collector for glazing integration
  - air-heating vacuum tube collector
  - glare protection BIPV-component

Visual mock-up for new BIPV component
Photos © Fraunhofer ISE
Objectives WP3

- develop 5 new façade components
  - transparent solar thermal collector for glazing integration
  - air-heating vacuum tube collector
  - glare protection BIPV-component
  - facade integrated natural ventilation system with heat recovery
Objectives WP3

- develop 5 new façade components
  - transparent solar thermal collector for glazing integration
  - air-heating vacuum tube collector
  - glare protection BIPV-component
  - facade integrated natural ventilation system with heat recovery
  - unglazed solar thermal collector plus heat pump
WP1: State of the art analysis and problem identification

WP2: Technical concepts, building categories and performance criteria

WP3: Development of new multifunctional components

WP4: Integrated concepts for cost-effective integration

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WP6: New business models and alliances

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Project Lifetime 4 years
Objectives WP6

- new business models and alliances
  - market analysis
  - new business models
  - verification with potential clients group

Refurbishment of the existing external envelope
Architect/Building Owner: Bouygues, France.
Source: Emmer, Pfenninger Partner
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Project Lifetime 4 years

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Objectives WP4

- “integrated” socio-economic concepts
  - using technical concepts from WP2
  - using economic concepts from WP6
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WP4: Integrated concepts for cost-effective integration

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WP7: Dissemination, standardisation, education and training

Project Lifetime 4 years
Objectives WP5

- Evaluation and demonstration of integrated concepts through retrofitting of a pilot building in Spain

Building of the University of Madrid
Demonstration in 8th and 9th floor. Source: Acciona
WP1: State of the art analysis and problem identification

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WP6: New business models and alliances

WP7: Dissemination, standardisation, education and training

Project Lifetime 4 years
Objectives WP7

- dissemination
- training
- standardisation
- solar air collectors
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Thank you for your attention!

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