European Energy Policy and Standardization - Buildings and Building Components

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http://ec.europa.eu/dgs/jrc

Serving society
Stimulating innovation
Supporting legislation
TOWARDS 2030

framework for climate and energy policies

• EU economy and energy system more competitive, secure and sustainable
• towards a low-carbon economy (Roadmap 2050)
• reduce EU domestic greenhouse gas emissions by 40% below the 1990 level by 2030 (emissions by at least 80% by 2050)
• share of renewable energy to at least 27%
• 30% energy savings target for 2030 (EED)
• **Buildings** have a huge potential to contribute to these targets
CONTEXT

Low Carbon Economy (2050)

- EU Energy Policy
  - Innovation of products, technologies
  - Sustainable Energy Consumption
  - Buildings and Transport
  - Economic and social stimulus

- EU Directives for implementation at M.S. level
  - EPBD, CPR, RESD, EED, INSPIRE, …

- EU Standardisation
  - CENELEC/IEC (energy efficiency, electricity including LVD)
  - CEN/ISO (energy performance, construction and products)
  - Member States regulations
BUILDING

• A protected enclosure (space/volume) taking into account its boundaries; climate, energy infra-structure and functionality.

• Key element in the energy infra structure

• For energy assessment the envelope is the most important part. It separates indoor- (volume) from outdoor environment.

• In terms of energy consumption:
  – Building needs; minimum requirements
  – Operational needs; apparatus, etc.
  – Occupancy/functionality energy needs
EU RELEVANT LEGISLATION

Agreement on reduction of CO₂ emission

- CPR (2011/305/EU) Construction Products Regulation
Construction Products Regulation

The Construction Products Regulation (CPR) lays down harmonised conditions for the marketing of construction products. Reliable information on construction products in relation to their performance is achieved by providing a common technical language and standardised assessment methods.

<table>
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<tbody>
<tr>
<td><strong>Energy performance &amp; Cost optimality</strong></td>
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<tr>
<td>- MSs: Minimum energy performance requirements</td>
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<tr>
<td>- Cost-optimal methodology (common framework)</td>
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<td>- Requirements for technical building systems</td>
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<td><strong>Existing Buildings</strong></td>
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<td>- All the buildings undergo major renovation should implement energy efficiency measures</td>
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<td>- Minimum requirements for buildings and components</td>
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<tr>
<td><strong>New Buildings</strong></td>
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<td>- Nearly Zero Energy Buildings</td>
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<td>- By 31 Dec. 2020 all buildings</td>
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<td>- National plans for nZEB</td>
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<tr>
<td><strong>Energy performance certification</strong></td>
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<td>- Implement EPC schemes</td>
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<td>- Recommendation for cost-optimal improvements</td>
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<tr>
<td>- Independent control systems</td>
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<tr>
<td><strong>HVAC inspection</strong></td>
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<tr>
<td>- Regular inspections (heating &gt; 20kW, AC&gt;12kW)</td>
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<tr>
<td>- Independent control systems</td>
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<tr>
<td><strong>Financial incentives &amp; Market barriers</strong></td>
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<tr>
<td>- MSs: to prepare lists of measures and instruments</td>
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<td>- Take into account cost-optim. for these measures</td>
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OBJECTIVE

Find a consensus on the application of modelling software tools for the assessment of energy consumption in the future low-energy building sector.

Energy Performance Assessment is a key-issue:
– Energy Performance Certificate
– Buildings; New and major renovation
– Cost Optimality Method
– Economic evaluation (renovation)
– Monitoring of performance
Energy Performance of Buildings

Directive 2010/31/EU article 2:

The ‘energy performance of a building’ means the calculated or measured amount of energy needed to meet the energy demand associated with a typical use of the building, which includes, inter alia, energy used for heating, cooling, ventilation, hot water and lighting;
CONTEXT

A ‘nearly zero-energy building’ means "a building that has a very high energy performance (very low amount of energy required associated with a typical use of the building including energy used for heating, cooling, ventilation, hot water and lighting)."

The very low amount of energy required by a nearly zero-energy building has to be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on site or nearby".
ENERGY AND BUILDINGS

Relation of energy consumption and energy performance of a building

- Building energy consumption; occupancy, culture and functionality
- Building systems; efficiency and M.S. energy mix
- Building fabric; climate and M.S. minimum requirements

Building
- Energy Consumption
- Energy Performance
PHILOSOPHY

The philosophy, TRIAS ENERGETICA that supports the reduction of energy consumption in building sector is presented in three priority steps:

1. Energy **saving** (improve insulation),
2. Increase energy **efficiency** (building installations),
3. Use **renewable energy** resources (solar energy, bio-energy, etc.).
BUILDING ENERGY CONSUMPTION

Energy Consumption in buildings (3 consumption categories):
Relation to Trias Energetica: minimise, maximise and optimise

1. Building energy needs (**minimise**; savings).
   related to indoor (comfort level of temperature, air quality and light) and outdoor climate conditions (temperature, solar radiation and wind) for comfortable working and living in buildings.

2. Building systems energy (**maximise**; efficiency).
   combined efficiency of the installations for heating, cooling, ventilation, hot water and electricity in relation to available energy mix, are the relevant factors in the end-use energy consumption.

3. Occupancy energy consumption (**optimise**; behavioural).
   The remaining use of energy depends on how the occupant makes use of the building, including control and gains.

Performance assessment deals with points 1 and 2.
PERFORMANCE ASSESSMENT

CEN energy standards related to the EPBD
TC371 (Energy Performance of Buildings)

• Calculation (simulation)
  – Methods for fabric, systems, climate, comfort, etc

• Measurement (on-site)
  – Whole building (volume; occupied, non-occupied)
  – Building elements (thermal transmission of envelope)

• From building perspective to energy network perspective (involves ICT)
  – Building a cornerstone of the infra structure
  – Security of local supply (peak supply / demand)
STANDARDIZATION

CEN and EPBD related energy standards

- TC371 *Energy Performance of Buildings*
- TC89 *Thermal Performance of Buildings and Building Components*
- WG13 *In-situ thermal performance of construction products, building elements and structures*

Standards

- EN 15603 Umbrella document
- TR 15615 Technical Report guidelines for 15603
- EN 13790 Calculation of Heating and Cooling needs
Position in set of EPBD standards

EN ISO 13790 is one of the key standards in the set of standards to support the EPBD.

Primary Energy

Efficiency
High Energy Performance Building

What is meant by nearly-Zero Energy Building? (EPBD 2010/31/EU)

• Rather a concept than a building
• Nearly-Zero
  – Thermal and electrical energy annual balance
  – *Balance* of Demand, Supply and Storage
• Energy
  – Energy consumption, GHG emissions (reduce)
• Building
  – From CPR (products) to EPBD (performance) to overall design
  – Traditionally consumes energy
  – Now are requested to produce energy
• **ICT** becomes an essential part of energy management
• **Urban area** (beyond the EPBD and other energy Directives)
RENEWABLE ENERGY

Building sector
- Direct: biomass, use of heat-pump, solar
  - Passive solar – design, orientation
  - Active solar
    - Thermal - water collectors
    - Electrical - PV systems
- Infra structure
  - Thermal – CHP (district)
  - Electricity
    - Yellow – nuclear
    - Black – fossil
    - Green - renewable

Source: Passive House Institute
EU BUILDING SECTOR

RE elec, heat (2005)
20% by 2020

Distributed conversion systems
Feasibility studies (EPBD art 5)

DIRECTIVES
STANDARDS
NORMS
Web-site http://re.jrc.cec.eu.int/pvgis

GIS-RAD

Climate

calculation

parameters

and data
Security of Energy Supply – Super Grids

- JRC contribution:
  - Communication on smart grids (202/2011)
  - Standards (Mandate 490)
  - European Industrial Initiative on Electricity Grids (SETIS)
  - Smart Grids Task Force (DG ENER)
- Industry:
  - MEDGRID
  - Eurelectric
  - ENTSOE
In Denmark wind power counts for about 50% of the total power.

Balancing problem

IMM has tools for:
- Wind power forecasting
- Solar power forecasting
- Optimal planning

Total power and wind power 2013:

www.enfor.dk
INSPIRE Directive

I

• General rules to establish an infrastructure for spatial information in Europe
  – Community environmental policies
  – Policies or activities which impact on the environment
• To be based on SDIs and LMOs established and operated by the Member States
• Does not require collection of new spatial data
• Scope:
  – Spatial data held by or on behalf of a public authority
  – 34 Spatial Data Themes laid down in 3 Annexes
• Entry into force 15 May 2007

Having regard to the Treaty establishing the European Community, and in particular Article 175(1) thereof,

(2) The Sixth Environment Action Programme adopted by
How INSPIRE is relevant for building energy assessment?

- One relevant theme: **Building**
- Current state of the data specifications:
  - Representations for buildings, building parts, openings, texture, etc.
  - 2D, 3D representations
  - Many thematic information, some may be relevant for building assessment (material of construction, etc.)

- **INSPIRE** could become a major data resource for building energy assessment
INSPIRE Thematic Scope

Annex I
1. Coordinate reference systems
2. Geographical grid systems
3. Geographical names
4. Administrative units
5. Addresses
6. Cadastral parcels
7. Transport networks
8. Hydrography
9. Protected sites

Annex II
1. Elevation
2. Ortho-imagery
3. Land cover
4. Geology

Annex III
1. Statistical units
2. Buildings
3. Soil
4. Land use
5. Human health and safety
6. Utility and governmental services
7. Environmental monitoring facilities
8. Production and industrial facilities
9. Agricultural and aquaculture facilities
11. Area management/restriction/regulation zones & reporting units
12. Natural risk zones
13. Atmospheric conditions
14. Meteorological geographical features
15. Oceanographic geographical features
16. Sea regions
17. Bio-geographical regions
18. Habitats and biotopes
19. Species distribution
20. Energy Resources
21. Mineral resources
SYNERGY and HARMONISATION

- Applications – Energy calculation, flows, grid
  - Construction Product Directive
  - Energy Service Directive
  - National laws
  - CEN Energy Standards (require calculations), EU Directives

- Enabling framework and exchange platform – INSPIRE Directive
  - Harmonized data, improved access, and data flow

- Databases
  - European (Eurostat, JRC) and national databases,
  - Climate data and regional parameters
DESIGN and REAL PERFORMANCE

- Simulation software coupled to real data

- Comfortable room temperature = green; red = too hot, blue = too cold

IEQ index (temperature/CO₂/etc.)

Above range
Above target, within range
On target
CEN EN 15251 Cat II
Below target, within range
Below range

Target values of temperature (FiSIAQ Cat S2)

Operativen lämpötila oleskeleykyvyltä [°C]

Temperature (24 h keskilavo) [°C]
GIS – ENERGY BUILDING

SolarGIS home [KnowledgeBase Account]

Welcome admin! Log in

1 Explore Map 2 PV Planner 3 Enhanced stats

Solar radiation and air temperature – monthly values (Plant output)

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PV System Parameters

- Installed power (kWp): 1
- Type of module: Crystalline Silicon (CM)
- Type of inverter: Conrec
- Other DC AC losses (%): 1.5
- Availability (%): 95.5

Mounting system:
- Azimuth (°): 262 South
- Inclination (°): 20

Calculate:

Solar radiation – monthly values

- Total system output and performance ratio: 1238 - 26.1
BUILDING STOCK

BPIE Europe’s buildings under the microscope; a country-by-country review of the energy performance of buildings (2011)

Over 75% of building stock is older than 25 years (estimation)

Averaged final energy consumption data
• Residential 185 kWh/m²
• Non-Residential 280 kWh/m²
THANK YOU

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