International standardisation activities on energy efficiency

Angelo Baggini*, Franco Bua**
* angelo.baggini@unibg.it - Università degli Studi di Bergamo
** franco.bua@ecd.it – ECD, Pavia, Italy

III International Conference on Energy Innovation
29th and 30th, May 2008
Barcelona
A Look at the Big Picture

- The Global Energy Problem
- How can Standards Help?
- What are the ongoing standardisation activities?
Oil price – 2005 outlook
Oil price – 2008 statistics
EE prices – Industrial consumer (24 GWh/y – c/kWh)
EE prices – Domestic consumer (3500 kWh/y – c/kWh)
EU - Energy dependency
Energy demand in final uses 1994-2005 (Mtoe)

- Residential
- Transportation
- Industry
EU15 - Environmental gas emission
CO2 emission

- Nuclear
- Renewables
- Production efficiency
- Final use electrical efficiency
- Fossil final use efficiency
EU Green Paper on Energy Efficiency

EU could save at least 20% of its present energy consumption in a cost-effective manner, equivalent to EUR 60 billion per year, or the present combined energy consumption of Germany and Finland:

- **Security of supply**: By 2030, on the basis of present trends, the EU will be 90% dependent on imports for its requirements of oil and 80% dependent regarding gas. Making a real effort to at first cap EU energy demand at present levels and subsequently reduce it, would represent an important contribution in developing a coherent and balanced policy to promote the security of energy supplies for the European Union.

- **Competitiveness and the Lisbon agenda**: Applying measures on energy efficiency also means the creation of many new high-quality jobs in Europe. Furthermore, a successful energy efficiency scheme means that some of the €60 billion not spent on energy translates as a net saving, resulting in increased competitiveness and better living conditions for EU citizens. In this way an average EU household could save between €200 and €1,000 per year in a cost-effective manner, depending on its energy consumption.

- **Environmental protection and the EU’s Kyoto obligations**: Energy saving is without doubt the quickest, most effective and most cost-effective manner for reducing greenhouse gas emissions, as well as improving air quality, in particular in densely populated areas. It will therefore help Member States in meeting their Kyoto commitments.
Energy efficiency role

Energy Efficiency Accounts for 78% of Potential Reduction in CO₂

End-Use Efficiency - Electriciy 29%

End Use Efficiency - Fossil Fuel 36%

Power Sector Efficiency & Fuel 13%

Increased Renewables 12%

Increased Nuclear 10%

Source: OECD/IEA World Energy Outlook 2006
Barriers (1)

- Lack of awareness of savings potential
- Inadequate performance efficiency information and metrics
- Component vs. systems approach
- Conflicting incentives
- Focus on initial vs. lifecycle cost
Barriers (2)

- budgetary disconnect between capital projects (equipment purchases) and operating expenses (energy and maintenance)
- System optimization knowledge resides with the individual who has been trained - it is not institutionalized
- Trained individuals leave or transfer and take this knowledge with them
- Processes change over time and inefficiencies can re-occur
How standards can help? (1)

- Innovation vehicle
- Quality assurance
- Elimination of trade barriers
- Competitiveness and exchange booster
- Consumer protection
How standards can help? (2)

- Performance measurement and test methods
- Codification of best practices and management systems
- Design checklists and guides
- Calculation methods
- Adaptation of infrastructure
- Interoperability
- Certification
Make it simple!

Ripartizione percentuale dei risparmi certificati rispetto alle tre metodologie di valutazione previste dalle Linee guida
(Fonte: elaborazioni su dati Autorità)

Fonte: Secondo rapporto annuale sul meccanismo dei titoli di efficienza energetica
EU Policy & Standardisation

- since the mid-1980s increased use of standards in support of EU policies and legislation (New Approach legislation)

- With specific reference to energy efficiency examples of this relationship can be given:
  - EPBD Mandate
  - EESD Mandate
EPBD Mandate (CEN)

Methodology for calculating energy performance

- Energy Performance Requirement
  - new buildings: Art. 4, 5
  - major renovations: Art. 4, 6

- Energy Performance Certificate and Recommendations
  - Art. 7

- System inspections
  - Art. 8, 9

- Ways of expressing energy performance
  - prEN 15217

- Energy certification of buildings
  - prEN 15217

- Overall energy use, primary energy, CO2 emissions
  - Total delivered energy
  - Procedures for calculated and measured energy rating
  - prEN 15603

- System and building energy needs for heating, cooling, humidification, dehumidification, hot water, lighting and ventilation systems
  - prEN ISO 13790, prEN 15316-1, prEN 15316-2, prEN 15243, prEN 15316-3, prEN 15265, prEN 15193, prEN 15241, prEN 15232

- Definitions and terminology, external climate data, indoor conditions, overheating and solar protection, thermal performance of building components, ventilation and air infiltration, etc.
  - prEN ISO 8966, prEN ISO 13370, prEN ISO 10077-1, prEN 13947, prEN ISO 10211, EN ISO 10077-2, prEN ISO 14883, prEN ISO 10458, prEN 15242, prEN 13779, prEN 15251, prEN ISO 15927, EN ISO 7345, EN ISO 6288, EN ISO 925, EN 12782

- Heating systems with boilers
  - prEN 15378

- Air conditioning
  - prEN 15240

- Ventilation systems
  - prEN 15239
## EU Directives

<table>
<thead>
<tr>
<th>Directive/Decision</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directive 2006/32/EC</td>
<td>End-use Efficiency &amp; Energy Services</td>
</tr>
<tr>
<td>Council decision of 18 December 2006</td>
<td>Energy Star Programme</td>
</tr>
</tbody>
</table>
## EuP Directive

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>boilers</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>water heaters</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>computers</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>imaging</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>televisions</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>standby</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>chargers</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>office lighting</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>street lighting</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>room air</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>motors</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>cold commercial</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>cold domestic</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>washing</td>
<td></td>
</tr>
</tbody>
</table>

- **study phase**
- **Consultation Forum phase**
- **Regulatory Committee phase**
- **Commission adoption phase**
- **draft final report stakeholder workshop**
- **meeting of the Consultation Forum**
- **vote by the Committee**
- **adoption by the Commission**

* includes WTO notification, translations and reinforced scrutiny by European Parliament
<table>
<thead>
<tr>
<th>Household</th>
<th>Power - W</th>
<th>Consumption kWh/y</th>
<th>Average use</th>
<th>Annual cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoover</td>
<td>1000</td>
<td>39</td>
<td>45 min/week</td>
<td>7,8</td>
</tr>
<tr>
<td>Electrical Boiler</td>
<td>1200</td>
<td>3000</td>
<td>120 L/d</td>
<td>600</td>
</tr>
<tr>
<td>Fridge</td>
<td>250</td>
<td>600</td>
<td>continuous</td>
<td>120</td>
</tr>
<tr>
<td>Dish washer</td>
<td>3000</td>
<td>700</td>
<td>1 wash/d</td>
<td>140</td>
</tr>
<tr>
<td>Washing machine</td>
<td>3000</td>
<td>210</td>
<td>2 wash/sett</td>
<td>42</td>
</tr>
<tr>
<td>TV</td>
<td>100</td>
<td>105</td>
<td>20 h/sett</td>
<td>21</td>
</tr>
<tr>
<td>Radio Alarm Clock</td>
<td>10</td>
<td>87</td>
<td>continuous</td>
<td>17,4</td>
</tr>
</tbody>
</table>
Standardisation ongoing activities

- General Assembly Resolution 5/2005
- ISO Council Resolution 35/2006 (Pilot process)
- Joint ISO-IEA position “International Standards to develop and promote energy efficiency and renewable energy sources” (WEC 2007)
- Portfolio analysis: ISO and IEC standards, EU mandates to CEN/Cenelec, US-based standards
- TMB resolution 22/2008: SAG on “Energy efficiency and renewable energy sources” (until February 2010)
Standardisation ongoing activities

2005 General Assembly:
“ISO should foster new initiatives and be more proactive in order to anticipate new fields where international standardization might support the dissemination of innovation”

ISO Council resolution 35/2006:
pilot process to complement the existing approaches for identifying and prioritizing innovative fields of work approved
Pilot process actions (so far):

- Contacts with key partners at international level
  - **IEA** - International Energy Agency
  - **WEC** - World Energy Council

- Portfolio analysis*
  - **Europe**
  - **USA**

(*draft submitted as CSC/STRAT 05/2006)
Standardisation ongoing activities

2007

ANSI (USA) and ABNT proposed to ISO a new field of technical activities for standards on **Energy Management Systems**

2008

ISO accepted with **TMB resolution 15/2008**: ISO/PC 242 “Energy Management”
SMB Decision 128/20 (2007): SMB-SG1 on energy efficiency and renewable resources

SMB-SG1 Terms of Reference (ToR):
- To analyse the status quo in the field of energy efficiency and renewable energy sources (existing IEC standards, ongoing projects)
- To identify “white spots”/gaps/opportunities, find new ways of achieving energy efficiency in the electrotechnical domain
- To set objectives for electrical energy efficiency (EEE) in products and systems
- To formulate recommendations for further actions
Standardisation ongoing activities

SMB Decision 128/20
New initiatives for IEC work

The SMB agreed to set up two SMB strategic groups to look into new initiatives for IEC work

- **SMB/SG 1**
  - on energy efficiency and renewable resources
  - **DE, CA, CN, ES, FR, GB, IT, JP and US**

- **SMB/SG 2**
  - on automotive electronics
  - **JP, DE, FR, IT, KR and the US**
Standardisation ongoing activities

SMB/SG 1 Terms of reference:

- **To analyse** the status quo in the field of energy efficiency and renewable energy sources (existing IEC standards, ongoing projects)
- **To identify** “white spots”/gaps/opportunities, find new ways of achieving energy efficiency in the electrotechnical domain
- **To set objectives for electrical energy efficiency** (EEE) in products and systems
- **To formulate recommendations** for further actions
Standardisation ongoing activities

Relevant technologies

- Electrical motors
- Converters and VSD
- Power transformers
- Production
- Lighting
- PFC systems
- DSM
- peak shaving, load shifting, ...
- Control systems
  (home and building automation)
- Maintenance
- Power quality
Standardisation ongoing activities

Relevant technologies
# Supply Chain Matrix

**Energy efficiency significance per application field**

<table>
<thead>
<tr>
<th>Application fields</th>
<th>Supply chain</th>
<th>Power Generation</th>
<th>Power Transmission</th>
<th>Power Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting</td>
<td>Box 1</td>
<td>Box 2</td>
<td>Box 3</td>
<td></td>
</tr>
<tr>
<td>Rotation</td>
<td>Box 4</td>
<td>Box 5</td>
<td>Box 6</td>
<td></td>
</tr>
<tr>
<td>Heating Cooling</td>
<td>Box 7</td>
<td>Box 8</td>
<td>Box 9</td>
<td></td>
</tr>
<tr>
<td>Data processing</td>
<td>Box 10</td>
<td>Box 11</td>
<td>Box 12</td>
<td></td>
</tr>
</tbody>
</table>

- **Red**: high significance
- **Blue**: medium significance
- **Green**: low significance
- **Black**: no significance
## Consumption Matrix

**Energy efficiency significance per application field**

<table>
<thead>
<tr>
<th>Application fields</th>
<th>Industrial</th>
<th>Private</th>
<th>Premises</th>
<th>Traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting</td>
<td>[Box 13]</td>
<td>[Box 14]</td>
<td>[Box 15]</td>
<td>[Box 16]</td>
</tr>
<tr>
<td>Rotation</td>
<td>[Box 17]</td>
<td>[Box 18]</td>
<td>[Box 19]</td>
<td>[Box 20]</td>
</tr>
<tr>
<td>Heating Cooling</td>
<td>[Box 21]</td>
<td>[Box 22]</td>
<td>[Box 23]</td>
<td>[Box 24]</td>
</tr>
<tr>
<td>Data processing</td>
<td>[Box 25]</td>
<td>[Box 26]</td>
<td>[Box 27]</td>
<td>[Box 28]</td>
</tr>
</tbody>
</table>

- **Red** indicates high significance
- **Blue** indicates medium significance
- **Green** indicates low significance
- **Gray** indicates no significance

Annex 2
Standardisation ongoing activities

ITU-T
- since 2006 study points on power management for xDSL (Study Group 15)

ETSI
- Energy efficiency is a strategic issue
Standardisation ongoing activities

- BT JWG Final report (BT N 7359)
  - List of priority areas
  - SFEM
    - TF 189 “Energy Management and related services”
      » PT “Energy Service Companies”
      » PT “Energy Management systems”
      » PT “Energy Managers and experts”
    - TF 190 “Energy efficiency and saving calculations”
      » PT “Top Down calculations”
      » PT “Bottom Up calculations”
Standardisation ongoing activities

CEN/CLC BT JWG Energy Management

Early 2002 to mid 2005

- CEN/CENELEC BT JWG “Energy Management”

Aim

- Initiate a European collective view of the general strategy for improvement of energy efficiency standardisation

Output:

- Final report (BT N 7359)
- Recommendation to CEN and CENELEC TBs to create a new horizontal strategic body on Energy Management (Sector Forum)
Objectives

- to create, implement and conduct an enlarged European network of energy experts in order to consider matters of strategic importance to the energy management sector and to facilitate the achievements of EU energy legislation and policy targets

SFEM Task Forces & Project Teams

- TF 189 “Energy Management and related services”
  - PT “Energy Service Companies”
  - PT “Energy Management systems”
  - PT “Energy Managers and experts”
- TF 190 “Energy efficiency and saving calculations”
  - PT “Top Down calculations”
  - PT “Bottom Up calculations”
Standardisation ongoing activities

CEN Standardisation on Energy Management and Energy Efficiency

European Level

- CEN/CLC Sector Forum Energy Management
  - With delegates nominated by the National Standardisation Bodies

  - BT CEN-CLC

  - CEN/CLC TF 169: Energy Management and related services
    - With delegates nominated by the National Standardisation Bodies

    - PT Energy Service Companies
    - PT Energy Management Systems
    - PT Energy Managers and Experts

  - CEN/CLC TF 190: Energy Efficiency and Saving Calculations
    - With delegates nominated by the National Standardisation Bodies

    - PT Top-Down Calculations
    - PT Bottom-Up Calculations

- Proposed new ITEM6/Technical Bodies:
  - e.g. green certificates, white certificates, Benchmarking, energy audit

- Other CEN and/or CLC Technical Bodies:
  - e.g. TC 113, BT TF 173 (M343), TC 350 (M340)

National Level: NSB

- NSB Mirror Committees

- ?
Three-phase oil-immersed distribution transformers 50 Hz, from 50 kVA to 2 500 kVA with highest voltage for equipment not exceeding 36 kV

“A potential saving of 22 TWh and 1 billion Euro for EU-15 can be achieved with the use of high efficient MV/LV distribution transformers” (Thermie project n. STR-1678-98)

Industrialized countries: 40% of transformers belongs to private customers (industry and commercial sector)
## NO load losses

<table>
<thead>
<tr>
<th>Rated power (kVA)</th>
<th>E&lt;sub&gt;0&lt;/sub&gt;</th>
<th>D&lt;sub&gt;0&lt;/sub&gt;</th>
<th>C&lt;sub&gt;0&lt;/sub&gt;</th>
<th>B&lt;sub&gt;0&lt;/sub&gt;</th>
<th>A&lt;sub&gt;0&lt;/sub&gt;</th>
<th>Vcc (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>190</td>
<td>145</td>
<td>125</td>
<td>110</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>320</td>
<td>260</td>
<td>210</td>
<td>180</td>
<td>145</td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>460</td>
<td>375</td>
<td>300</td>
<td>260</td>
<td>210</td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>650</td>
<td>530</td>
<td>425</td>
<td>360</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>315</td>
<td>770</td>
<td>630</td>
<td>520</td>
<td>440</td>
<td>360</td>
<td></td>
</tr>
<tr>
<td>400</td>
<td>930</td>
<td>750</td>
<td>610</td>
<td>520</td>
<td>430</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>1100</td>
<td>880</td>
<td>720</td>
<td>610</td>
<td>510</td>
<td></td>
</tr>
<tr>
<td>630</td>
<td>1300</td>
<td>1030</td>
<td>860</td>
<td>730</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>630</td>
<td>1200</td>
<td>940</td>
<td>800</td>
<td>680</td>
<td>560</td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>1400</td>
<td>1150</td>
<td>930</td>
<td>800</td>
<td>650</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>1700</td>
<td>1400</td>
<td>1100</td>
<td>940</td>
<td>770</td>
<td></td>
</tr>
<tr>
<td>1250</td>
<td>2100</td>
<td>1750</td>
<td>1350</td>
<td>1150</td>
<td>950</td>
<td></td>
</tr>
<tr>
<td>1600</td>
<td>2600</td>
<td>2200</td>
<td>1700</td>
<td>1450</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>3100</td>
<td>2700</td>
<td>2100</td>
<td>1800</td>
<td>1450</td>
<td></td>
</tr>
<tr>
<td>2500</td>
<td>3500</td>
<td>3200</td>
<td>2500</td>
<td>2150</td>
<td>1750</td>
<td></td>
</tr>
</tbody>
</table>
# Load Losses

<table>
<thead>
<tr>
<th>Rated Power (kVA)</th>
<th>Load losses (W)</th>
<th>Vcc (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$D_k$</td>
<td>$C_k$</td>
</tr>
<tr>
<td>50</td>
<td>1350</td>
<td>1100</td>
</tr>
<tr>
<td>100</td>
<td>2150</td>
<td>1750</td>
</tr>
<tr>
<td>160</td>
<td>3100</td>
<td>2350</td>
</tr>
<tr>
<td>250</td>
<td>4200</td>
<td>3250</td>
</tr>
<tr>
<td>315</td>
<td>5000</td>
<td>3900</td>
</tr>
<tr>
<td>400</td>
<td>6000</td>
<td>4600</td>
</tr>
<tr>
<td>500</td>
<td>7200</td>
<td>5500</td>
</tr>
<tr>
<td>630</td>
<td>8400</td>
<td>6500</td>
</tr>
<tr>
<td>630</td>
<td>8700</td>
<td>6750</td>
</tr>
<tr>
<td>800</td>
<td>10500</td>
<td>8400</td>
</tr>
<tr>
<td>1000</td>
<td>13000</td>
<td>10500</td>
</tr>
<tr>
<td>1250</td>
<td>16000</td>
<td>13500</td>
</tr>
<tr>
<td>1600</td>
<td>20000</td>
<td>17000</td>
</tr>
<tr>
<td>2000</td>
<td>26000</td>
<td>21000</td>
</tr>
<tr>
<td>2500</td>
<td>32000</td>
<td>26500</td>
</tr>
</tbody>
</table>

$Um < 24\,\text{kV}$