Energy efficiency building standards in Taiwan

Taiwan adopted building energy standards for air-conditioned, non-residential buildings in 1995 and for residential buildings in 1997. These mandatory national standards are being rigorously implemented, with demonstrated compliance needed for a building permit to be granted. At present, the standards cover only the performance of the building envelope, although energy performance criteria for the HVAC and lighting systems for the non-residential standard have been also proposed. In addition to mandatory standards, Taiwan has also been working towards voluntary building energy efficiency programs such as building energy labeling, a very successful green building certification program, and demand-side management (DSM) programs.

Status of Building Energy Efficiency Standards

Taiwanese government institutions responsible for building energy efficiency are the Bureau of Energy, Construction and Planning Agency of the Ministry of the Interior, the Architecture and Building Research Institute, and the Environmental Protection Administration. The building energy efficiency standards were developed by the Bureau of Energy and the Architecture and Building Research Institute, in collaboration with the Chinese Architecture and Building Center, National Cheng Kung University, National Sun Yat Sen University, and the National Taipei University of Technology.

Scope. There are two building energy efficiency standards, one developed in 1995 for air-conditioned non-residential buildings, and another in 1997 for residential buildings. These have been adopted at the national level and are mandatory for the building types to which they apply (offices, commercial buildings, hotels, and hospitals for the non-residential, housing for the residential standard). The enforcement of the standards is estimated at over 80 percent with compliance needed for a building permit to be granted.

Contents. The Taiwanese non-residential building energy standard is a simplified performance standard that, as of the date of this report, covers only the energy performance of the building envelope. Instead of prescribing the levels of wall and roof insulation, or the thermal and optical properties of the windows, the standard uses a simple multi-linear regression equation, ENVLOAD, to calculate the annual cooling load of the perimeter spaces and sets maximum allowable loads for the building envelope. Minimum allowable efficiencies for the HVAC and lighting system have also been proposed, but have not yet been implemented. The concept of separating the building energy performance into two parts – that of the building envelope and HVAC system efficiency – is very similar to the PAL (Perimeter Annual Load) and CEC (Coefficient of Energy Consumption) methods that Japan uses.

ENVLOAD stands for “Envelope Load” and means the annual total sensible cooling loads in the building’s perimeter zones extending inwards 5 meters from the exterior walls, as well as the top floor and bottom floor if the floor slab is exposed to the outside air. The cooling loads of the interior zones are considered to be dominated by internal gains, and controlled by requirements for the HVAC system efficiency. The ENVLOAD index is a regression equation made up of two meteorological variables (DH, IHk) and three architectural design variables (G, L, Mk). The meteorological variable DH describes the cumulative indoor-outdoor temperature differences (similar to degree days), while IHk describes the amount of solar radiation by orientation. These have been tabulated for seven climate zones of Taiwan. The architectural variable L describes the

insulation performance of the building envelope, Mk its overall solar heat gain coefficient, and G its internal loads. The regression coefficients a_0, a_1, a_2, and a_3 in the general equation

$$ENVLOAD = a_o + a_1*G + a_2*L*DH + a_3*\Sigma Mk*IHk$$

were computed from regression analysis of a large number of computer simulations. The equation gives the estimated annual perimeter cooling load in kWh/m^2·year for a building in a given location. The building standard sets maximum allowable ENVLOAD indices for different buildings in three parts of Taiwan (see Table 1). Figure 1 shows the three climate zones.

Table 1. Maximum ENVLOAD indices for air-conditioned buildings allowed by the 1995 commercial building energy standard

Building Type	Climate Zone	Maximum ENVLOAD indices (kWh/ m^2·year)
Offices	North	80
	Central	90
	South	115
Commercial buildings	North	240
	Central	270
	South	315
Hotels	North	100
	Central	120
	South	135
Hospitals	North	140
	Central	155
	South	190

Figure 1. Climate Zones for Taiwan's Building Energy Standard

Taiwan adopted its residential building energy standard 1997. It is a prescriptive code with U-factor requirements for the roof and walls, and a Req index for fenestration. The standard has been approved at a national level, but there are regional variations.

Jurisdiction. The commercial standard was adopted as a national law in 1995, and the residential standard in 1997. Although developed by both the Bureau of Energy and the Construction and Planning Agency of the Ministry of Interior, only the latter institution is responsible for its implementation. The standards are part of the building permit process for new buildings, which is also under the jurisdiction of the Construction and Planning Agency. To get a building permit, the building owner must submit documentation showing that the proposed building design meets the mandatory requirements set forth in Table 1. Failure to do so will result in denial of the building permit. It is estimated that as of 2006, over 80 percent of new construction projects are in compliance with the ENVLOAD requirements.

Status of Voluntary Non-Regulatory Programs

In addition to the mandatory building energy standard, Taiwan has also developed voluntary building energy efficiency programs such as an Energy Labeling Program and a very successful green building certification program called the Green Building Evaluation System, as well as DSM programs.

1. *Green Building Certification Program.* The Green Building Certification Program is a voluntary program but is mandatory for any new public building construction project which is funded by government more than about $1.5 million US. In 1999, the Architecture Research Institute of the Ministry of the Interior developed a Green Building Evaluation System, called EEWH (Ecology, Energy, Waste and Healthy; EEWH) and *Evaluation Manual for Green Buildings in Taiwan* that, according to some experts, has been very successful and in many ways has taken the public spotlight from the building energy efficiency standard. The manual evaluates biodiversity, green landscaping, site water conservation, CO_2 emission reduction, waste reduction, indoor environment, water resources, sewage and garbage treatment, as well as energy conservation. Compared to the ENVLOAD indices for the appropriate building type, the Green Building Certification program requires efficient lighting system design and an additional 20 percent reduction in the building's sensible space cooling load in perimeter zones, U-factor or solar heat gain from fenestration, as well as an additional 20 percent reduction in energy use for air-conditioning.

2. *Building Energy Labeling.* The energy labeling program for building is not yet implemented. However, the Bureau of Energy has launched a Energy Labeling Program for appliances and office equipment and also announced the voluntary energy benchmark for many types of buildings (see http://www.moeaec.gov.tw/Promote/%AB%D8%BFv%AA%AB%A5%CE%B9q%B0%D1%A6%D2%AB%FC%BC%D0.doc)

3. *Demand-Side Management Programs.* The Bureau of Energy is promoting these programs, in conjunction with Taiwan Power Company. For more detailed information, please refer to http://www.taipower.com.tw/left_bar/45453err/management_electricity.htm

Related end-use efficiency programs

4. For information on appliance labeling, please refer to http://www.energylabel.org.tw/

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