



# Energy and Resource Efficiency in Building Construction and Management – City of Zürich, Switzerland

## Background

Energy and ecological aspects of city development and building management have a long tradition in Zürich, dating back to the beginning of the 80s. In 1997, the city council decided to introduce an Environmental Management System (EMS) according to ISO 14001. Under the resulting management system, a list of sustainable development goals for city-owned new and refurbished buildings was drawn up and approved in 2002. The goals became known as the 7 Milestones for Energy and Resource Efficient Building Construction and Management, incorporating several energy standards used in Switzerland and across Europe.

## Strategy and objectives

Initially, the focus of the EMS was on the environmental impact of office operations, such as energy and paper use. In 2001, for the first time, indirect environmental goals were drawn up for construction projects—the core function of the Office for Building Construction. At the same time a similar management system was introduced in the newly founded Office for Building Management, which controls the real estate used for city's activities (administration, schools, public health services, etc.). Standards to achieve the goals of both systems were consolidated into the Building Department's 7 Milestones Programme for Energy and Resource Efficient Building Construction, to be in effect until 2010.

The 7 Milestones Programme defines the energy standard for buildings in accordance with the municipal energy policy or Master Energy Plan, adopted in 2002. The Master Energy Plan calls for:

- Reducing fossil fuel (oil and gas) consumption in municipal buildings by 15% by 2010 (compared with 2000 levels),
- Reducing carbon dioxide (CO<sub>2</sub>) emissions from fossil fuel used in municipal heating and vehicles by 15% by 2010 (compared with 1990 levels),
- Stabilising the consumption of electrical power in municipal buildings by 2010 to the level used in 2000.

## Economic dimension

The City of Zürich owns about 4,000 buildings with a value of about 10 billion CHF (approximately Euro 6,400 million) and manages approximately 10,000 apartments. In recent years, around 60% of investments were made in new construction and only 40% in refurbishing existing buildings. The City's municipal budget totals 7 billion CHF (approximately Euro 4,500 million)



## Step by step....towards meeting the City's energy policy

The 7 Milestones Programme is based on the Swiss MINERGIE<sup>1</sup> building standard and is applied to all city-owned buildings. The standards in the 7 Milestones Programme, which take into account both building construction and management, are:

1. New buildings must follow the MINERGIE standard (offices, schools: specific energy demand for heating and warm water less than 40 kWh/m<sup>2</sup>). Exceptions apply for special cases if a reason is given.
2. For refurbished buildings, 25% of the energy reference area shall meet the MINERGIE standard (offices, schools: specific energy demand for heating and warm water less than 70 kWh/m<sup>2</sup>).
3. New buildings and 50% of refurbished buildings must meet the MINERGIE lighting standard. Office and household appliances purchased must meet stringent energy efficiency standards, based on the Top Ten. All appliances must meet the most efficient category in energy consumption, class A, of the European Energy Label.
4. Renewable energy must be considered for all buildings and must meet at least 25% of heating requirements in new buildings.
5. Eco-friendly building construction and materials must have no health risks and must meet the Zürich Building Department's specifications on "Building and Ecology."<sup>3</sup> Indoor environmental pollution should be well below official limits or guidelines.
6. Environmental sustainability must be a decision-making criterion for architectural competitions and preliminary studies.
7. Building management must be performed according to environmental criteria that include energy performance, green procurement, environmentally-friendly maintenance, cleaning and disposal, and sustainable portfolio management.

## Building Ecology and Indoor Environmental Quality

In the early planning stage, detailed checks are carried out on all refurbishment projects to determine whether there are harmful pollutants such as asbestos, etc., in the existing building or inadmissible electromagnetic fields from electrical installations, transformer stations, etc. The building materials must meet the required ecological and toxicological standards. Material efficiency is increased by the use of a large share of recycled concrete. Indoor air measurements (e.g., formaldehyde, total volatile organic compounds (TVOC)) are carried out after construction has been completed for many projects. Throughout the process the construction is systematically checked against the building design to ensure that pressure to meet deadlines and costs does not have an unfavourable impact on indoor air quality.

## Environmental Sustainability in Architecture Competitions

Environmental and resource efficiency requirements are judged when architecture competitions are carried out during the planning and design phase. Simple energy and life-cycle analysis are carried out on the designs presented as part of a pre-test, upon which the

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<sup>1</sup> MINERGIE is a registered trade mark and quality label for new and registered buildings. The trademark is supported by the Federal Government, the Cantons and also by trade and industry.



results are taken into account when deciding on the winning entry. As a benefit, the pre-test information can be used to improve the winning project.

## Results

The reporting for the 7 Milestones Programme takes into account all construction projects worth over 5 million CHF (approximately Euro 3 million).

- By the end of 2005, 120,000 m<sup>2</sup> of new buildings (approximately 70% of permits issued between 2002 and 2005) and 80,000 m<sup>2</sup> of refurbished buildings (approximately 30% of permits issued between 2002 and 2005), meet MINERGIE standards<sup>2</sup>.
- By the end of 2004, energy efficient lighting meeting the Swiss Engineers and Architects Association standards was incorporated into 49 buildings with an illuminated area of 170,000 m<sup>2</sup>. In addition, 37 new buildings and refurbishments with an area of 125,000 m<sup>2</sup> meet the MINERGIE lighting specifications. The reported savings in electrical power amount to 750,000 kWh (35%) or 150,000 CHF per year.
- With better insulation and ventilation, new benefits have been created, such as improved indoor air quality and better protection from noise pollution.
- Shares for renewable energy (2005: 35% for new buildings) and waste heat recovery (2005: 20% for new buildings) have increased rapidly in new and refurbished building projects within the city.

A few examples:

- Waste heat recovery—By using 1,000 MWh of energy from the exhaust gases emitted by the heating plant of a large housing complex, it will be possible to heat all new school buildings and sport facilities (23,000 m<sup>2</sup> energy reference area) under construction at this location. By using a heat pump with environmentally-friendly refrigerant propane, 580 MWh of waste heat per year is extracted from a sewer to heat an existing school building.
- Solar energy—In various residential areas and senior citizens' homes, warm water is preheated using solar panels. The roofs of public buildings, preferably schools, are leased to private firms that install solar panels. They supply the power to the Solar Stock Exchange of EWZ, the local public utility company.

Pilot and demonstration projects have made it possible to gain experience with technologies and methods that will become state-of-the-art within the next 10 years. One example is the competition for an energy concept that was carried out for the refurbishment of a city hospital. The winning concept responded to the energy standard set by the 2000-Watt-Society. The target is a reduction in energy use per person in Switzerland from the current amount of 6000 W to 2000 W (with 500 W from non-renewable sources) by 2050<sup>5</sup>.

Due to its outstanding results, the 7 Milestones Programme has a strong influence on private sector building.

In May 2005, Zürich was awarded the European Energy Award<sup>®</sup> GOLD label, the award's highest standing for energy efficiency and renewable energy use.

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<sup>2</sup> It should be noted that energy efficiency renovations in older buildings may be limited by economical considerations, the need to preserve architectural heritage, etc., and thus the potential for energy savings can be diminished.



## Key replication aspects

The 7 Milestones Programme is successful because it has the full support of the entire city council. The programme is in principle suitable for other cities and towns, however it must be adapted to the size of the community and the varying climatic zones.

The MINERGIE standard is a useful aid to building owners when they are determining and enforcing the building standards in design and construction. Conducting and communicating a cost-benefit analysis of MINERGIE buildings can gain support for energy efficient construction among politicians and the public. Various projects have demonstrated that a public-private partnership with the participation of companies, suppliers, scientists and building owners can lead to the development and practical testing of sustainable products for the building market. This leads to better results than the development of one-off products.

It is critical to promote the successes of energy efficiency projects to political authorities, the public and the business community to ensure general acceptance of the 7 Milestones Programme. Only then can the public become fully aware of the benefits of sustainable building and the contribution it can make to a higher quality of life in the city.

- **Staff:** Approximately 110 employees staff the Office for Building Construction. At the Centre for Sustainable Building, 200% of a full-time position is assigned to the implementation of the 7 Milestones Programme and supports the 70 project managers. Staff is responsible for environmental management, consulting on construction projects and architecture competitions, managing studies and pilot projects, participating in expert groups, and public relations. At the Centre for Energy and Building Engineering a further 250% of a full-time position is available. In addition a network of external specialists help contribute to this program.
  
- **Budget and Financing:** The yearly investment volume of the Office for Building Construction was 400 million CHF (approximately Euro 260 million, and 1% of Switzerland's total building volume). The implementation of the 7 Milestones Programme requires 0 to 10% higher investment costs for new buildings and refurbishment. In the long-term, these extra costs can be partially recuperated due to lower operating costs. The annual budget for the Centres for Sustainable Building and Energy and Building Engineering for studies, research and pilot projects is 750,000 CHF (approximately Euro 480,000).

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## References

1. MINERGIE-standard: [www.minergie.ch](http://www.minergie.ch) (German and French)
2. Topten for energy efficient appliances: [www.topten.ch](http://www.topten.ch) (German)
3. "Building and Ecology" specifications and the Centre for Sustainable Construction: [www.stadt-zuerich.ch/nachhaltiges-bauen](http://www.stadt-zuerich.ch/nachhaltiges-bauen) (German and English section)
4. *naturemade* certification: [www.naturemade.ch](http://www.naturemade.ch)
5. 2000-Watt-Society: [www.novatlantis.ch](http://www.novatlantis.ch)
6. European Energy Award: [www.european-energy-award.org](http://www.european-energy-award.org)
7. eco-bau building label for sustainability and public building: [www.eco-bau.ch](http://www.eco-bau.ch) (German and French)

## Other References:

- City of Zurich Building Department: [www.stadt-zuerich.ch/hochbau](http://www.stadt-zuerich.ch/hochbau) (German)
- City of Zurich energy policy and Master Energy Plan: [www.stadt-zuerich.ch/energie](http://www.stadt-zuerich.ch/energie) (German)

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