E4 Project
Energy Efficient Elevators and Escalators

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ISR – University of Coimbra
Portugal
E4 – Project
Energy Efficient Elevators and Escalators

Project Partners

- ISR – University of Coimbra
- European Lift Association
- Italian National Agency for New Technologies, Energy and Sustainable Economic Development
- Fraunhofer Institute for Systems and Innovation Research
- Polish National Energy Conservation Agency
E4 - Project

Major tasks:

1. Market characterisation
2. Monitoring campaign
3. Technology assessment
4. Evaluation of savings potential
5. Identification of barriers and strategies for market transformation
Electricity consumption shares in tertiary sector in the EU

- Lighting
- Misc. building technologies
- Hot water
- Ventilation and air-conditioning
- Refrigeration
- Electric Heating
- Lighting street
- ICT data centers
- Circulation pumps and other heating auxiliaries
- Cooking (in hotels, health)
- ICT office
- Elevators
Information was collected by means of a survey with the cooperation of 19 national lift and escalator manufacturers and installers associations.

The purpose of the survey was to overcome the lack of information related to the lifts and escalators installed base.
Around 4.5 million lifts in the 19 countries surveyed
Around 115,000 lifts are installed in Europe each year
European Lift Market

Lift Distribution according to building type

- Residential: 64%
- Office: 14%
- Hospital: 5%
- Industrial: 4%
- Commercial: 4%
- Hotel: 4%
- Senior Residences: 2%
- Traffic: 1%
- Others: 1%
European Lift Market

Lift distribution according to the technology used
European Escalator Market

According to ELA, there are approximately 75,000 escalator units installed in the EU-27, of which 60,000 units in commercial buildings and the rest in public transportation facilities (train stations, airports, etc.). It is estimated that 3,500 new units are installed each year.
Monitoring Campaign

A monitoring campaign was carried out within the E4 project as a contribution to the understanding of energy consumption and energy efficiency of lifts and escalators in Europe.

– 74 Lifts
– 7 Escalators
Monitoring Campaign

Typical cycle of a traction lift
Monitoring Campaign

Typical cycle of a hydraulic lift

Running mode traveling up
Braking arriving at the floor
Running mode traveling down
Opening of the hydraulic valve
Standby consumption

Active power [kW]

Time [s]

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Monitoring Campaign

Travel cycle consumption of the lifts audited in the tertiary sector
Monitoring Campaign

Running specific energy consumption of monitored lifts in the tertiary sector [mWh/kg.m]
Monitoring Campaign

Travel cycle consumption of the lifts audited in the residential sector.
Running specific energy consumption of monitored lifts in the residential sector [mWh/kg.m]
Monitoring Campaign

Measured standby power in the lifts audited in the tertiary sector
Monitoring Campaign

Measured standby power in the lifts audited in the residential sector

Measured standby power ranges from 15 W to 710 W
Proportion of standby and running mode to overall energy consumption of lifts in the tertiary sector
Proportion of standby and running mode to overall energy consumption of lifts in the residential sector
Active power of an escalator in different operation modes
Monitoring Campaign

Annual electricity consumption of the monitored escalators

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Estimation of Energy Consumption
Lifts

Combined information from:

- Market characterisation
- Monitoring campaign

Annual Consumption  18 TWh
Running

- Assume the best available efficiencies for each of the components in the lift:
- Motor efficiency: 15% lower losses than IE3 in IEC60034-30
- (Super Premium or Permanent Magnet Synchronous Motors)
- Efficiency of helical gear – 96%
- Friction losses (5%)
- Efficiency of VSD (95%)
Estimation of Potential Savings for Lifts

Standby

**BAT**
- LED Lighting (varies from 12 W for lift with load 320 kg to 18 W for 1,000 kg load lift)
- Electronic Controllers (25 W)
- Inverter (20 W)
- Door operators (5 W)

**BNAT**
- Consider turning off of all non-essential components which contribute to the stand-by energy consumption when the lift is not in use.
- Consider putting the controller and inverter into sleep-mode (1 W each).
A total reduction of 10 TWh is achieved using the Best Technologies Available and of 12 TWh when technologies that are currently being available but currently not used in the lift industry.
Estimation of Energy Consumption
Escalators

According to ELA statistics, there are 75,000 escalators and moving walks installed in the EU-27. Based on the surveys conducted in WP2, two assumptions are made:

– 75% of the escalators are installed in commercial buildings and the remaining 25% in public transportation facilities.
– 30% are equipped with a Variable Speed Drive (VSD)

Based on the measurements conducted in WP3, the average value for the electricity consumed during running and standby modes (slow-speed and stopped), is considered.
Estimation of Energy Consumption

Escalators

Escalators energy consumption is estimated at 900 GWh per year
Estimation of Potential Savings
Lifts

• For the estimation of energy savings it is considered that all of the escalators installed would be equipped with VSD. Furthermore, it is considered that when stopped, the controller and inverter only consume one Watt each.

• A potential reduction in the electricity consumption of around \textbf{255 GWh (28\%)} would be possible
Barriers, strategies and guidelines

1) Identify relevant barriers that are present in the European lift and escalator market
   - **Barrier**: a mechanism that inhibits a decision or behavior that is both energy-efficient and economically efficient
   - **Methodology**: literature review, expert interviews and validating group discussions

2) Develop strategies to overcome the barriers identified

3) Provide guidelines how to improve energy efficiency
How important is energy efficiency on the European lift and escalator market?

- The issue has been discussed for some time.
- The discussion is related to the societal debate around climate change.

The awareness for energy efficiency seems to be higher...

- ... for manufacturers of lifts and escalators than for buyers of installations.
- ... for owners of grand scale installations (e.g. airports, high-rise segment) than for ‘normal’ customers (e.g. residential sector).
- ... for lifts than for escalators.
Is energy-efficient technology for lifts and escalators also economically efficient?

- Responses are ambiguous and even experts come to different conclusions (e.g. wide ranges regarding costs)
- High complexity of the products (e.g. interaction between components)
- Individually engineered installations rather than standardized products
- No generally accepted standards implemented for measuring energy consumption
- Rapid technological advances

- Few general conclusions:
  - Assessment easier for new installations than for retrofits.
  - Switching off the cabin light if the lift is not operating seems to be the only measure that is (more or less) accepted to be efficient in terms of energy and costs.
What are the barriers to energy-efficiency?

- No monitoring of energy consumption and energy costs of existing installations.
- Customers lack knowledge on energy efficient technology.
- Main source for information are manufacturers (and their sales departments).
- Installations are usually chosen without a (comprehensive) assessment of their energy consumption.
- An installation is often not chosen by the later operator/user of the installation; thus life-cycle approaches are neglected.
  - Maintenance and energy costs are usually divided between several occupants of a building.
  - The consumption of 3 to 8% of the whole energy consumption of a building may be too low to raise attention.
What’s not a barrier?

- Technology
  - Energy-efficient technology is available on the market and it works well (no increased need for repair or maintenance).

- Capital
  - New installations: Split incentives may hinder investment into more efficient technology, however not a general lack of capital.

- Legislation
  - No conflict identified with existing guidelines/regulation/legislation.
  - More important: lack of legislative/regulative framework to support the dissemination of energy-efficient technology.

- Comfort and safety
  - Energy-efficiency is not seen in conflict with comfort and safety issues
What needs to be done? Recommended strategies and measures.

- Standardized and transparent guidelines how to measure energy consumption and calculate annual energy demand of an individual installation on a European level
  - Concepts to draw on: ISO 25745, VDI4707, SIA 380-4, E4 project
- Inclusion of lifts and escalators into EPBD
- Raising awareness and enhancing knowledge
  - Main target groups
    - New installations: stakeholders involved in the planning and construction process of buildings
    - Existing installations: owners, users and operators
  - Measures
    - Labeling of equipment
    - Access to ‘objective’ information
    - Awareness campaigns for target groups
# Lift energy efficiency certificate according to VDI 4707

<table>
<thead>
<tr>
<th>Manufacturer:</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location:</td>
<td>Street</td>
</tr>
<tr>
<td></td>
<td>City</td>
</tr>
<tr>
<td>Lift model:</td>
<td>Series/Version</td>
</tr>
<tr>
<td>Lift type:</td>
<td>electric operated passenger lift</td>
</tr>
<tr>
<td>Nominal load:</td>
<td>630 kg</td>
</tr>
<tr>
<td>Nominal speed:</td>
<td>1 m/s</td>
</tr>
<tr>
<td>Operating days per year:</td>
<td>365</td>
</tr>
</tbody>
</table>

**Standby demand:** 40 W (energy demand class A)
**Specific travel demand:** 0.50 mWh/(kg·m) (energy demand class A)

**Usage category 2 according to VDI 4707**
Comparison of energy efficiency classes is only possible under equal usage.

Date: 01.03.2009
Reference: VDI 4707 Part 1 (issue 03-2009)

Energy efficiency class:
- A
- B
- C
- D
- E
- F
- G

Nominal demand per year for nominal values as shown: 550 kWh
How to implement energy-efficiency? – Guidelines

- Lifts and escalators are individually engineered systems rather than off-the-shelf products or standardized products
  - general guidelines are difficult to develop
- Energy efficiency concerns the whole life cycle of an installation, including
  - creating awareness and knowledge within the industry and beyond
  - selecting appropriate equipment
  - using this equipment in an energy-efficient manner
  - ensuring sensitivity to energy efficiency matters for installation and maintenance
Some examples

- e.g. appropriate location and number of installations
- e.g. dimensioning, energy efficient motors
- e.g. high-efficiency lighting and components
- e.g. switch-off equipment, sleep-modes
- e.g. integration into the building, installation quality

Awareness & knowledge
Complete information and detailed reports of each of the projects work packages can be found on:

www.e4project.eu