



Renovation of Denkendorf City Hall

Germany


EUROPEAN ALUMINIUM

/ Preface

To illustrate how the energy performance of existing buildings can be upgraded, the European Aluminium compiled the below case study.

Denkendorf City Hall is an office building offering 1900 m² of working space on 4 levels. Its renovation in 2011 mainly consisted in the replacement of the windows installed when the building was erected in 1967, by new windows matching today's energy efficiency requirements. The old windows were dismantled resulting in the collection of 4 tons of aluminium profiles that were sent to recycling, while only 2,4 tons of aluminium were necessary to manufacture the new windows.

A simplified life cycle assessment (LCA) of the new windows, focused on greenhouse gases, has been carried out and concluded a CO₂ payback period of 29 months, when recycling is neglected, and a payback period of 15 months when recycling is taken into consideration. The use phase data were modeled based on data from energy bills. The production phase was modeled based on the material composition. The end-of-life phase of the new windows was calculated as two scenarios, i.e. with and without end-of-life recycling.

An independent expert has been involved in order to secure the scientific validity and technical quality of the life cycle assessment.

It should be noted that the environmental benefits coming from the recycling of 4 tons of aluminium coming from the old windows were not included in the LCA.

/ Denkendorf City Hall: Description



- Building type: office
- Location: Denkendorf (D)



- Construction year: 1967
- Floor: 1900m²



/ Denkendorf City Hall: Window replacement

Old windows:

- Non-thermally-broken alu frames
- Double glazing
 - $g_{gl}=0,78$
 - $\tau_{gl}=0,73$
- $U_w=4,30 \text{ W/m}^2\text{K}$



New windows:

- Thermally-broken aluminium frames
- Triple glazing
 - $g_{gl}=0,70$
 - $\tau_{gl}=0,73$
- $U_w=0,9 \text{ W/m}^2\text{K}$



/ Denkendorf City Hall: Data for CO₂ calculation

Bill of material for renovation

- Aluminium: 2421 kg
- Glass: 7008 kg
- Polyamide: 334 kg
- PVC: 125 kg
- EPDM: 378 kg
- Gaskets: 152 kg
- Coating: 595 kg
- Others: 24 kg
- TOTAL: 11037 kg

Material sent to recycling

- Aluminium: 4000 kg not considered in CO₂ calculation

Heating energy demand

- Before renovation: 280 MWh/year
- After renovation: 205 MWh/year

Heating energy source

- Natural gas
- 234 g CO_{2-eq} / kWh

/ Denkendorf City Hall: CO₂ calculation results

Savings during operation:

- Energy savings: 75,000 kWh/year
- CO₂ savings: 17,550 t
- Acc. To energy bills

Production and recycling

- CO₂ emissions: 42,419 t, if recycling is ignored
- CO₂ emissions: 21,925 t, with 92% recycling credits*

Payback period

- 29 months, if recycling is ignored
- 15 months, with 92% recycling credits*



REVIEW STATEMENT

Case Study: Renovation Denkendorf City Hall
Commissioner: European Aluminium Association AISBL, Brussels, Belgium
Reviewer: Prof. Dr. Matthias Finkbeiner, Berlin, Germany

Scope and Reference of the Review

The review of the case study is focused on the general criteria of scientific validity and technical quality. The review assessed whether the methods used to carry out the CO₂ and energy calculation are scientifically and technically valid, whether the data used are appropriate and reasonable in relation to the case study and whether the interpretations reflect any limitations of the study in a transparent and consistent manner.

The assessment of formal compliance with a particular reference document or standard as well as the verification of individual data or results is outside the scope of the review.

This review statement is valid for the presentation and calculation provided on 18.12.2012.

Review Process

The review process started with the delivery of the case study documentation to the reviewer. The reviewer provided questions for further clarification on the data used for the case study. The calculation was checked for plausibility and spot-checks were performed to assess the reproducibility of the calculation.

Review Results

The calculation was documented transparently in a spreadsheet and provides a CO₂ payback period of 29 months (no recycling) respectively 15 months (with recycling). The use phase data were modeled based on data from energy bills. The production phase was modeled based on the material composition, i.e. without production losses. The end-of-life phase was calculated as two scenarios, i.e. with and without recycling. The data used are appropriate and reasonable in relation to the case study. The simplification to model the production based on the material composition should be clearly documented.

Overall, the assessment was found to be technically and scientifically valid.

Prof. Dr. Matthias Finkbeiner
Berlin, 20.12.2012

/ Study realized in cooperation with...

- Building owner: Bürgermeisteramt Denkendorf
- Energy consultant: Krämer-Evers Bauphysik
- Window system supplier: Sapa Building Systems
- Window manufacturer: Metallbau Schneider
- Demolition & recycling: Mr. Riewas
- Life-cycle analysis: European Aluminium
- External review: Prof. Dr. Mattias Finkbeiner