Comparison of different measures for reducing the carbon footprint of the building sector – a rental house case study

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We make it easy to make the environmentally best choice
Content of the presentation

1. Nordic Swan ecolabelling of buildings
2. LCA comparison between a Nordic Swan building and reference buildings
3. Effect of additional measures on carbon footprint
4. Conclusions and recommendations
Nordic Swan ecolabelling of buildings
Official Ecolabel of the Nordic Countries

Started in 1989 by the Nordic Council of Ministers

Purpose: to make it easy for consumers to find environmentally friendly products and for companies to produce them.

Strong in the Nordic countries

ISO 14024 type I – ecolabel

Over 60 product groups including e.g. papers and detergents, houses, hotels and funds.
Criteria decision and development

Relevance:
Size of the environmental problem?

Potential:
Possibilities for environmental improvements?

Steering:
How can the Nordic Ecolabel influence the production of the product?
Ecolabels for sustainable & green procurement

- Nordic Swan Ecolabel makes it easy for both consumers and professional buyers to choose the environmentally best goods and services
- Public purchasers are allowed to require Ecolabels in EU tenders Directive 2014/24/EU on public procurement
- Contracting authorities may require a specific Ecolabel as means of proof
  - In the technical specifications
  - In the award criteria
  - In the contract performance conditions
Nordic Swan ecolabelling criteria for buildings

- Obligatory requirements O1-O41
- Voluntary point-score requirements P1-P14
- Fulfil stringent environmental and health requirements
- The whole building lifecycle has been taken into account
- Small energy consumption
- Inspected building materials and chemicals, material log book
- Good indoor environment
- Quality control under construction, control of supply chain including sub-contractors and product suppliers

Requirements for
renewable, recycled and sustainable raw materials

Sustainable use of resources and energy

Strict chemical requirements

Focus on quality requirements and lifetime

Requirements for optimal waste and resource management

Requirements for product design, disassembly and repairability

Collection

Consumption use and reuse

Remanufacturing

Production

Distribution

Design

Recycling

Raw materials

Waste
Nordic Swan ecolabelled building compared to Finnish building requirements

- Wider perspective to safe and environmentally conscious construction, e.g. use of chemical substances and material
- Tighter requirements for materials, energy-efficiency and utilization of natural daylight
- More comprehensive inspection of the indoor environment, reducing the emission levels in indoor air\(^1\)
- Ecolabelled buildings have a lower carbon footprint\(^2\)

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\(^2\) Ahola R, Liljeström K. Rakennuksen elinkaaren hiilijalanjäljen pienentäminen kustannustehokkaasti vuokratalokohtessa.
Climate effect of a Swan ecolabelled building

Inspected materials
Wood and green concrete
Recycled materials

High recycling rate of construction waste

Energy class A
Good indoor climate

Material log book:
Well-known and safe materials

Picture source: Finnish Ministry of Environment
2. LCA comparison between a Nordic Swan building and reference buildings
Life-cycle carbon footprint of case buildings

- Life-cycle carbon footprint calculation was made for 4 new apartment house buildings constructed by NCC
- One house, Kaskelantie 1, has achieved the Nordic Swan ecolabel
- Calculation was made with One Click LCA calculation program
Life-cycle carbon footprint calculation results

Specific carbon footprint, kg $\text{CO}_2e/\text{brm}^2$

- Kaskelantie
- Lipputie
- Marsinkuja
- Loiskekuja

Production | Construction | Use | Demolishing
3. Effect of additional measures on carbon footprint
Effects of different measures on carbon footprint

• Additional carbon footprint calculation was done for Kaskelantie 1 to estimate the effect of alternative design solutions increasing the energy-efficiency

• Both the effect of a single measure and the total effect of several measures were compared to the base case
## Effect of alternative design solutions on the life-cycle carbon footprint of Kaskelantie 1

<table>
<thead>
<tr>
<th>Measure</th>
<th>Effect, kg CO₂e / m² GFA</th>
<th>Investment, €/tnCO₂e</th>
<th>Lifecycle cost €/tnCO₂e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Annual ventilation heat recovery efficiency 66.7 % -&gt; 78.0 %</td>
<td>-56</td>
<td>110</td>
<td>-30</td>
</tr>
<tr>
<td>2. Window U-value 0.8 -&gt; 0.6</td>
<td>-24</td>
<td>300</td>
<td>120</td>
</tr>
<tr>
<td>3. Decentralized demand-controlled ventilation in flats</td>
<td>-57</td>
<td>90</td>
<td>-50</td>
</tr>
<tr>
<td>4. Attic floor U-value 0.13 -&gt; 0.07</td>
<td>-9</td>
<td>1 030</td>
<td>840</td>
</tr>
<tr>
<td>5. Outer wall U-value 0.17 -&gt; 0.14</td>
<td>-13</td>
<td>330</td>
<td>130</td>
</tr>
<tr>
<td>6. Base floor U-value 0.16 -&gt; 0.10</td>
<td>-2</td>
<td>1 240</td>
<td>1 050</td>
</tr>
<tr>
<td>7. Air-tightness value 2 -&gt; 1 m³/h,m²</td>
<td>-17</td>
<td>190</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total effect of measures 1.-7.</strong></td>
<td><strong>-161</strong></td>
<td><strong>240</strong></td>
<td><strong>40</strong></td>
</tr>
<tr>
<td>8. Decentralized ventilation system instead of centralized</td>
<td>-97</td>
<td>70</td>
<td>-40</td>
</tr>
</tbody>
</table>
4. Conclusions and recommendations
4 measures to minimize the carbon footprint of buildings

1. Utilization of renewable energy sources

2. Increasing energy-efficiency
   - Ventilation system design has a large effect: preferring demand-controlled ventilation, effective heat recovery from outlet air, decentralized ventilation units

3. Increasing material-efficiency
   - Increasing the lifetime of the building & considering both the flexibility of the building use and material recycling possibilities already in the design phase

4. Favouring of low-emission materials
   - Low carbon concrete and renewable and/or recyclable building materials – also new solutions should be developed and taken into use
Conclusions

• The lifecycle footprint of the Nordic Swan ecolabelled house was 17 % lower than the largest calculated lifecycle footprint (Loisketie 1). Around 65 % of the lifecycle carbon footprint was caused by the energy consumption and only 20 % by the building materials.

• Potentially decreasing carbon emissions of energy production will increase the importance of the building materials in the future.

• Carbon footprint calculation is a necessary step to enable the evaluation and future restriction of the life-cycle carbon footprint of a building.

• Calculation should guide the design of the building & enable design choices ending into a lower carbon footprint.
Recommendations

• Voluntary ecolabelling of buildings can enhance the construction industry into continuous improvement and speed up the technological development.

• Example:
  • EU is enhancing the calculation of embodied energy and CO₂ emissions of building materials during the whole life cycle. The Finnish Ministry of Environment is currently piloting the carbon footprint calculation method.
  • Nordic Swan Ecolabel co-operates in Finland by having introduced the calculation of the carbon footprint as a voluntary point-score requirement in building ecolabelling criteria.

• Ecolabelling can in general act as a test bench for upcoming (building) regulations:
  • Possible new regulations integrated as obligatory or voluntary requirements in ecolabelling criteria.
  • Forerunners as licence applicants pilot the new requirements.
  • Experiences from piloting are utilized in turning the requirements into regulations.