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

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Nordic Swan ecolabelling of buildings

Official Ecolabel of the Nordic Countries

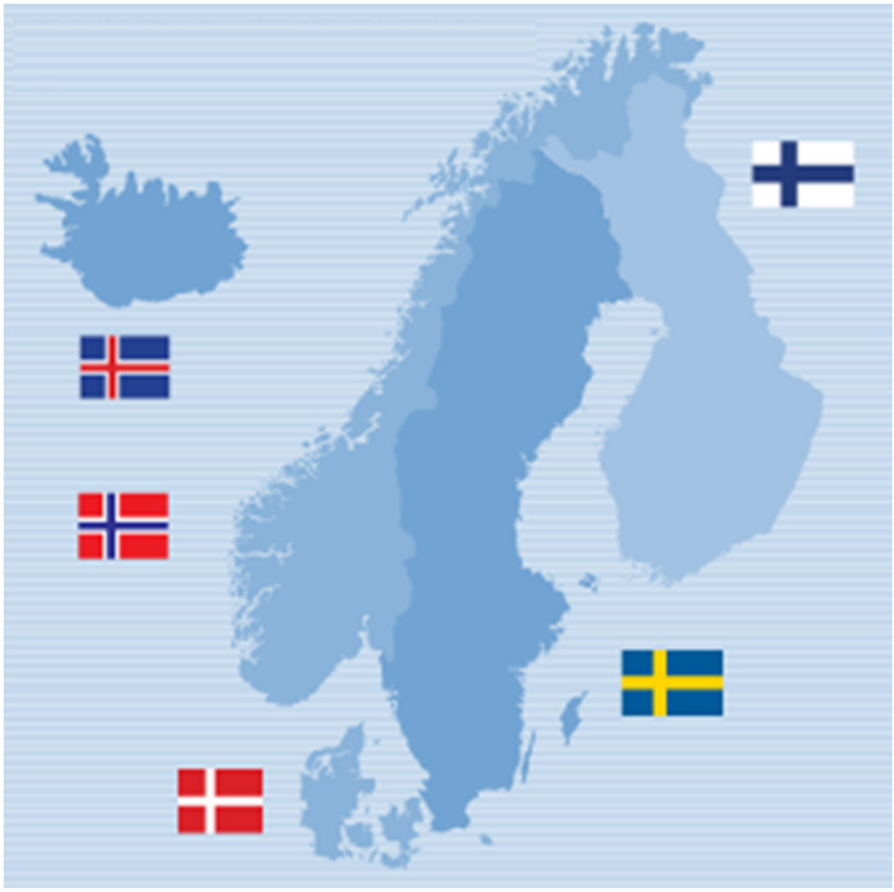
Started in 1989 by the Nordic Council of Ministers

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.



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Criteria decision and development

Relevance:

Size of the environmental problem?

Potential:

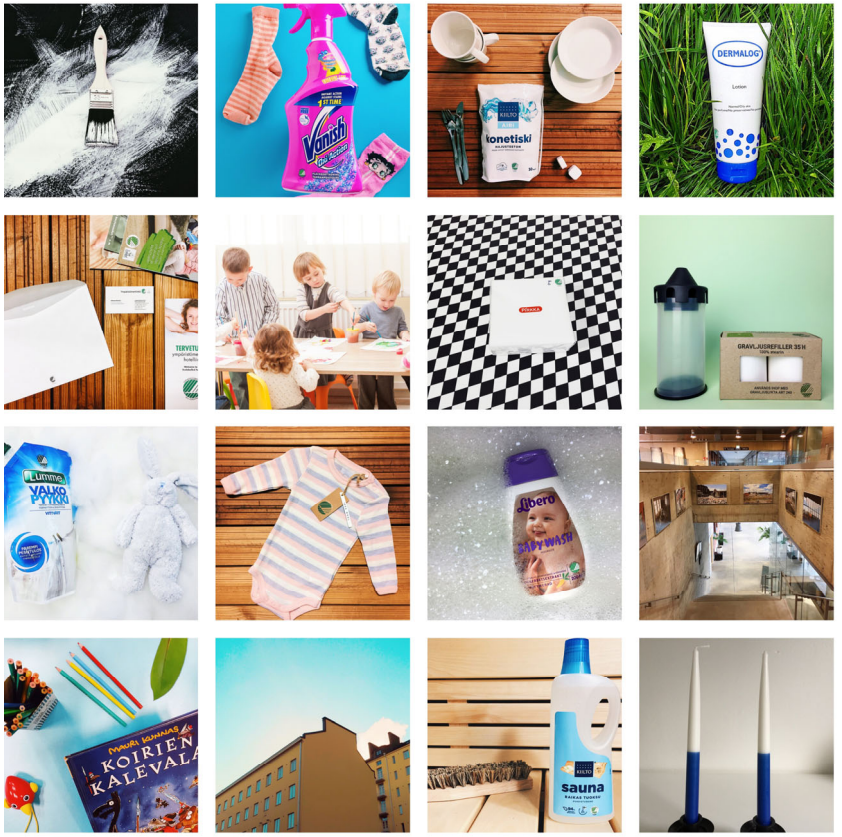
Possibilities for environmental improvements?

Steering:

How can the Nordic Ecolabel influence the production of the product?

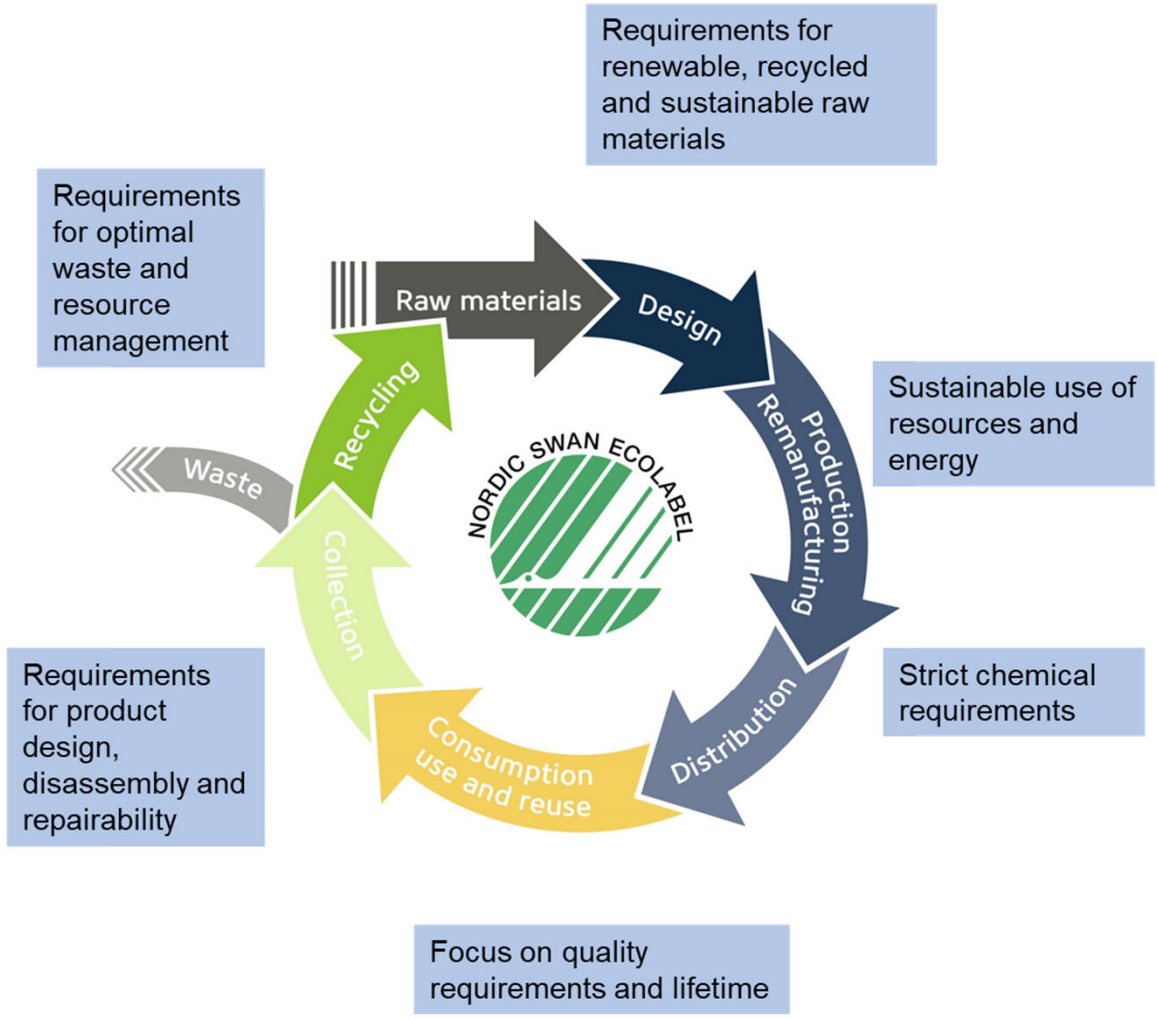
Ecolabels for sustainable & green procurement

- 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



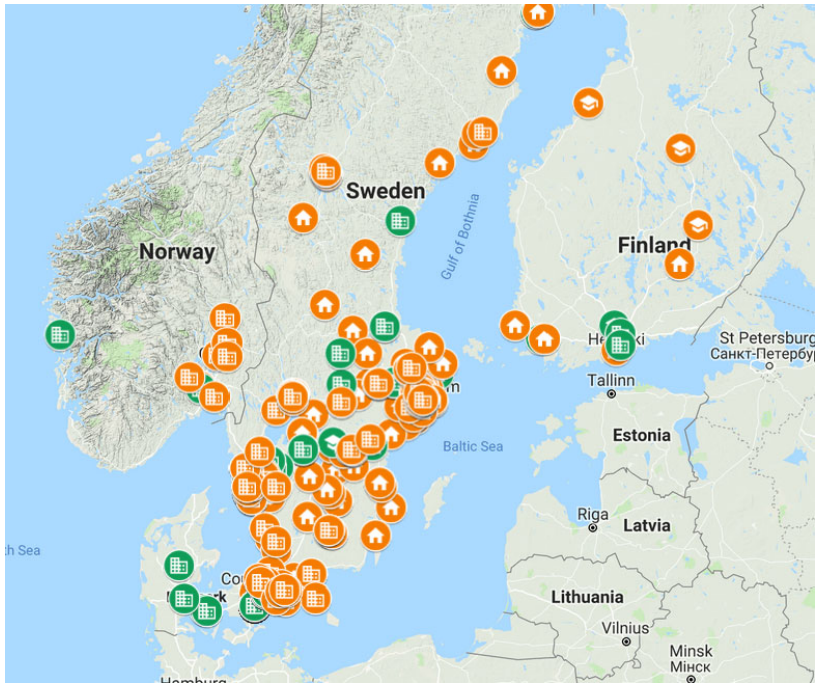
Nordic Swan ecolabelling criteria for buildings

- 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-constructors and product suppliers



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]



[1] Persson J. Indoor air quality and chemical emissions of organic compounds in newly built low-energy preschools. Doctoral thesis. Örebro University 2018.

[2] Ahola R, Liljeström K. Rakennuksen elinkaaren hiilijalanjäljen pienentäminen kustannustehokkaasti vuokratalokohteessa.

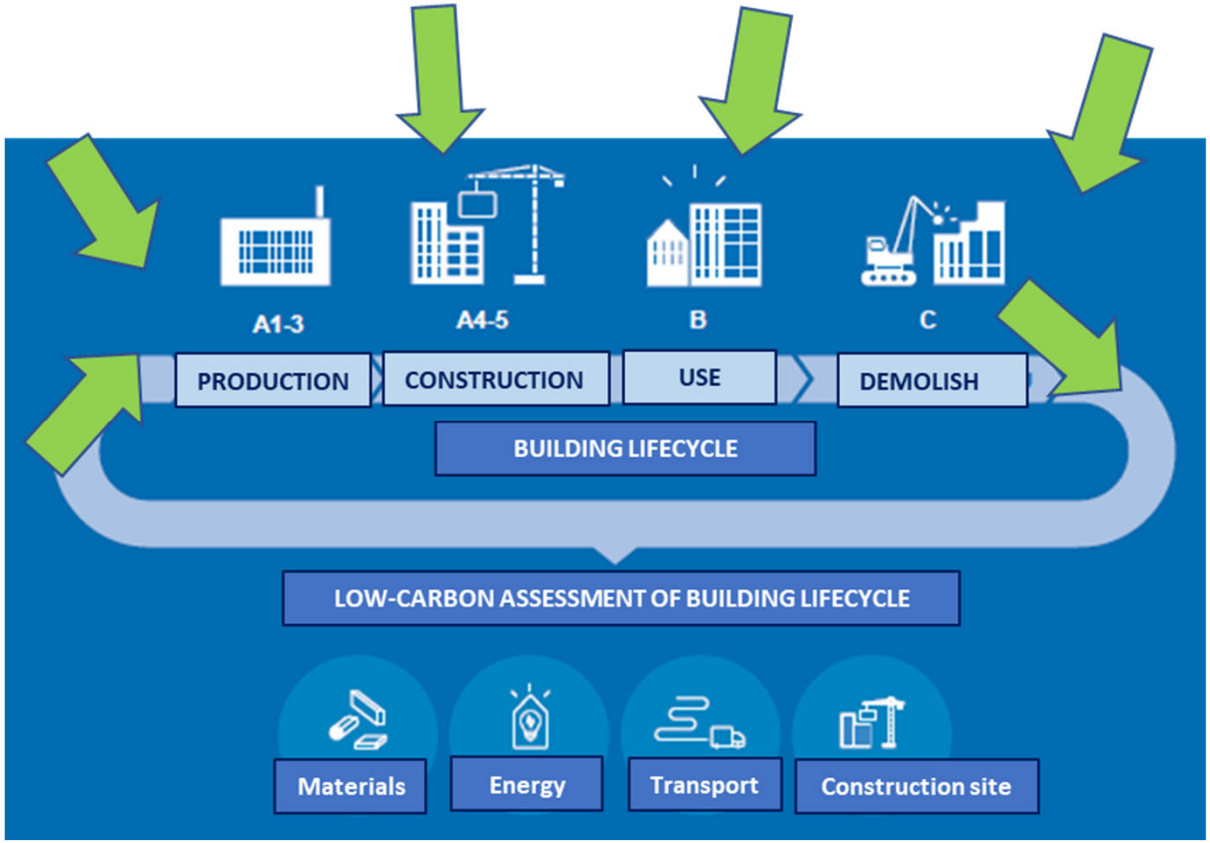
Climate effect of a Swan ecolabelled building

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



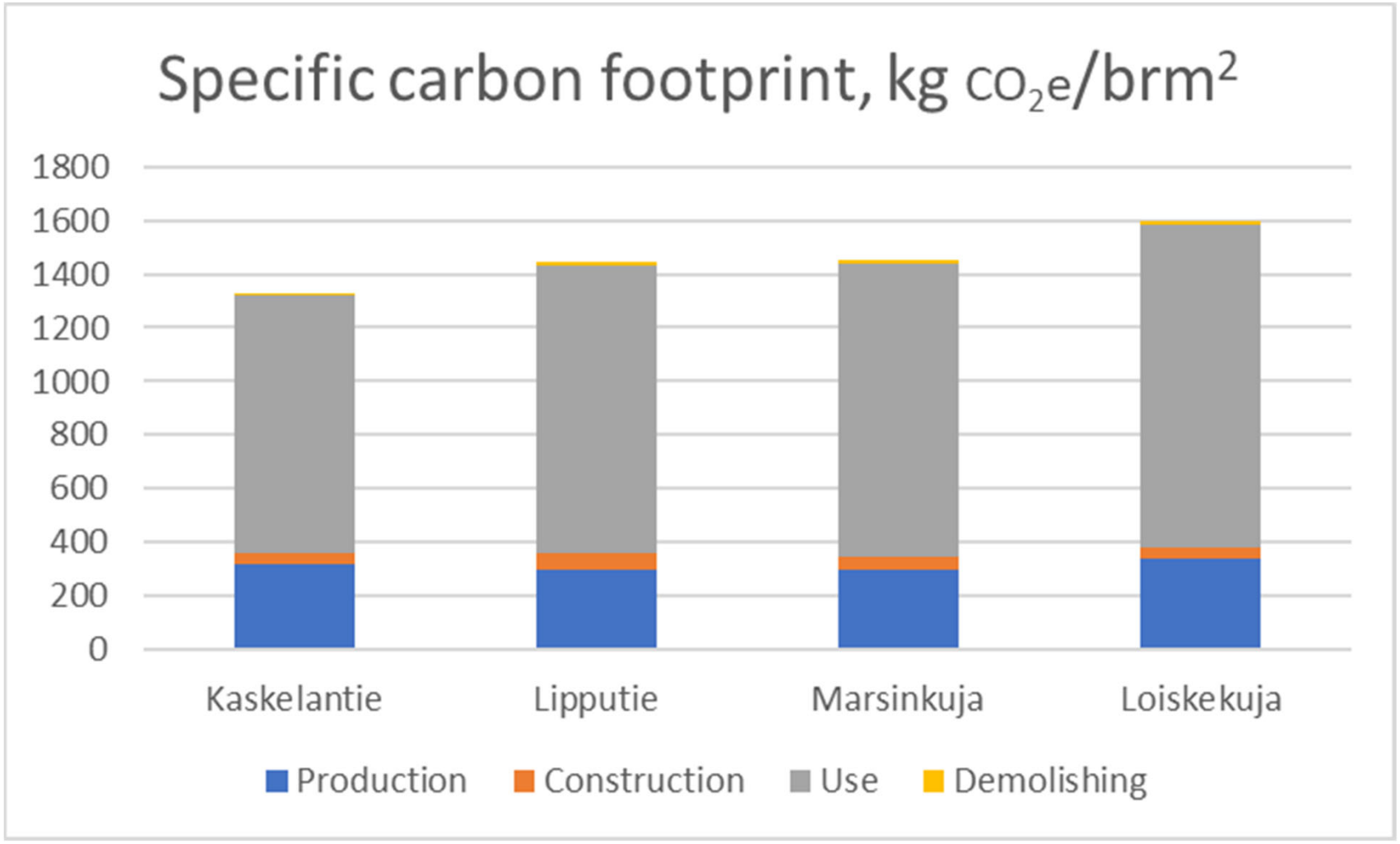
Picture source: Finnish Ministry of Environment

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



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

Measure	Effect, kg CO_2e / m^2 GFA	Investment, €/tnCO_2e	Lifecycle cost €/tnCO_2e
1. Annual ventilation heat recovery efficiency 66.7 % -> 78.0 %	-56	110	-30
2. Window U-value 0.8 -> 0.6	-24	300	120
3. Decentralized demand-controlled ventilation in flats	-57	90	-50
4. Attic floor U-value 0.13 -> 0.07	-9	1 030	840
5. Outer wall U-value 0.17 -> 0.14	-13	330	130
6. Base floor U-value 0.16 -> 0.10	-2	1 240	1 050
7. Air-tightness value 2 -> 1 $m^3/h,m^2$	-17	190	10
Total effect of measures 1.-7.	**-161**	**240**	**40**
8. Decentralized ventilation system instead of centralized	-97	70	-40

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 CO_2 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