NTNU
Trondheim

Norwegian University of Science and Technology
Faculty of Architecture and Fine Art
Department of Design, History and Technology

REPORT

Title: **Environmental assessment of the re-development project of Borgen Community Centre**

Authors: **Inger Andresen, Anne Grete Hestnes**

Date: 09.03.2005

INDEX

Summary

The report describes the results of an environmental evaluation of the re-development project Borgen Community Centre at Asker, near Oslo. The assessment was carried out during the schematic design phase of the project.

A simplified environmental assessment was performed based on the Norwegian method for environmental assessment of buildings – EcoProfile. The method targets existing dwellings and commercial buildings, and minor adjustments have been made in order to make it better suitable for public buildings in the design phase.

The assessment identified potential environmental impacts of the project in a life cycle perspective. In addition, it revealed the need for developing simple tools for environmental assessments during the design process. The existing method offers too much detail in some issues and too little in others. Unconventional solutions, like natural/hybrid ventilation, can hardly be evaluated within the method. The interaction between different systems can not easily be detected. For this, a more dynamic simulation tool is needed. The method functions well as a check-list for relevant topics to consider in order to reduce the environmental loads of the project.

Some topics were judged to be of special relevance to the succeeding re-development process. These were elaborated:

Energy use and indoor environment: insulation and air tightness, user controlled air supply, light and temperature, heat recovery of ventilation air, cooling, renewable energy sources, daylight access, moisture, low-emitting materials in surfaces, and ease of maintenance.

Choice of materials and solutions: space efficiency, flexibility, accessibility, re-use and re-cycling, robustness, materials hazardous to health and environment.

Waste: Waste reduction and treatment of environmentally hazardous waste. Production of a waste management plan.

1. Introduction

A complete environmental assessment of a building project will in an ideal situation comprise all environmental impacts through its entire life cycle, from the extraction of raw materials to deconstruction and possible re-use (see Figure 1). Life-Cycle Assessment, LCA, is the method most commonly adopted for environmental evaluation internationally. Ideally such an approach should be used as the basis for environmental documentation also in building project. However, a complete LCA is extremely complex and time-consuming. Thus, in practice, a simplified approach needs to be taken in building projects.

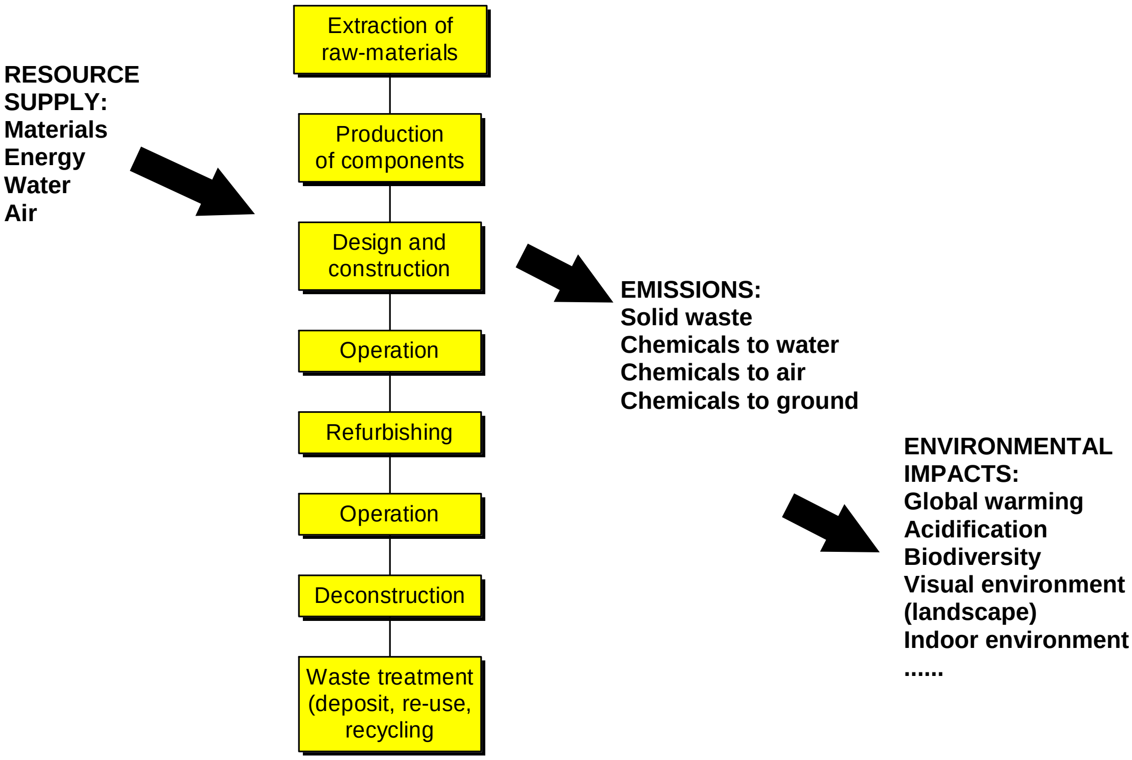


Figure 1. Environmental evaluations in the life-cycle perspective of a building.

In connection to the schematic design phase of the new Borgen Community Centre in Asker, an environmental evaluation of the proposed new design of the school building was to be carried out. Because of the limited extent of the project, the evaluations had to be somewhat simplified. The goal of the evaluation was to identify major environmental issues and possible improvements.

In addition, the assessment exercise would also give useful input for developing better tools for environmentally sound design of school buildings.

2. Environmental aspects of the building design

The building was designed with special attention to the following environmental aspects:

- *Natural/hybrid ventilation*

The ventilation system is designed to utilize natural buoyancy forces to distribute air through the building. This reduces the energy for running fans. The fresh air is led through underground ducts, cooling the air in the summer and heating it during wintertime. In addition, a system for heat recovery from exhaust air is installed. These measures give a significant reduction of energy needs for heating and cooling purposes. In addition, the ventilation levels are season- and demand adjusted, giving appropriate levels of ventilation at all times.

- *Utilizing thermal mass*

To even out temperature swings during the day, the thermal mass of the building is utilized by exposing the compact ceiling constructions. This is especially effective in terms of reducing the cooling load. In addition, this strategy involves reduced materials use (no false ceiling).

- *Exploiting the daylight resources*

Daylight is an important factor for users spending much of the day indoors. Daylight contributes to well-being and alertness, factors essential for effective learning. Several scientific surveys indicate that users having good access to daylight in their workplace are more satisfied and perform better than colleagues with poor daylight conditions. (Burge, Hedge et al. 1987; Küller and Lindsten 1992; Hathaway 1995; Nicklas and Bailey 1996; Jesch 1998; PG&E 1999).

The building is designed with skylights, giving good daylight access in the rooms without causing glare. Model studies and analyses document that high light levels and appropriate daylight distribution have been obtained.

- *Control system for armatures*

Artificial lighting is connected to a control system that reduces light levels when there is sufficient daylight and turns off artificial light in unoccupied spaces. This saves substantial amounts of electricity prolongs armature lifetimes.

- *Re-use*

Floor slab and column/beam system are kept, and bricks from exterior walls are used in new interior walls.

- *Heat pump*

A geothermal heat pump is planned, giving substantial reductions in the energy need for heating.

- *Shared use of space*

Space efficiency and flexibility may be the most important factors in terms of minimizing resource use during construction and operation. The home-bases are planned for various pedagogical settings. Students may be divided into smaller groups or merged into larger units.

3. The EcoProfile method

In Norway, there is merely one method available for producing simplified environmental assessment of buildings: EcoProfile for buildings (GRIP 1996). In the evaluation of the school building, EcoProfile was used to the extent it was found feasible. EcoProfile is a tool for environmental assessment of dwellings and commercial buildings and has been developed by The Norwegian Building Research Institute among others. In EcoProfile, the building is classified in three main categories: Exterior environment, Resources and Indoor climate.

Adapting the EcoProfile method
Presently, there is no environmental assessment tool available that is especially adapted to school buildings in Norway. In the EcoProfile assessment of Borgen Community Centre, the EcoProfile method for commercial buildings was used as the basis. EcoProfile for commercial buildings presently offer no parameters for evaluation of material- and land use. These parameters were included by using the parameters from EcoProfile for dwellings. Since EcoProfile is designed for assessing existing buildings, some parameters are more or less irrelevant for new building design. These have been excluded or adjusted. The forms in chapter 8 show the evaluated parameters. The parameters that are marked in yellow are from EcoProfile for commercial buildings, the grey ones are from EcoProfile for dwellings, while green ones have been adjusted. Some parameters are marked in blue, indicating that they have been found irrelevant for evaluating new public buildings in the design phase, and therefore have been left out of the assessment.

Environmental classification
In the EcoProfile method, the three main areas ”Exterior environment”, ”Resources” and ”Indoor climate” are divided into sub-criteria, see Figures 2 to 4. All parameters are evaluated in three levels, where level 1 means “smaller environmental load”, level 2 means “medium environmental load” and level 3 means “high environmental load”. Each parameter evaluated is given a score of 1, 2 or 3 points, showing how the chosen solution performs. The forms given in chapter 8 include more detailed descriptions of the classifications.

Adjustment by importance
In addition, the different criteria within each main group are given weights. In Figures 2 through 4, the given factors are listed in bold. For instance, in the category “Resources”, water use has been given a weight of 1, while energy use has received 10, indicating that energy use is far more important to address than water use. In the EcoProfile method, no arguments are presented for the given weights, as they are mainly given from estimates and public discernment. To some extent, different weights have been given to the same parameters in the “commercial building” and “dwelling” versions of the method. In general, determining the weights is the most discussed and controversial dimension to environmental evaluations. Hence, there is no objective, correct way of determining how to give the different parameters importance. For the evaluation of Borgen Community Centre, the rule of thumb has been to follow the weights given in EcoProfile for commercial buildings, with some adjustments from EcoProfile for dwellings for parameters used from that method.

Both parameters and weights are further discussed in section 5.

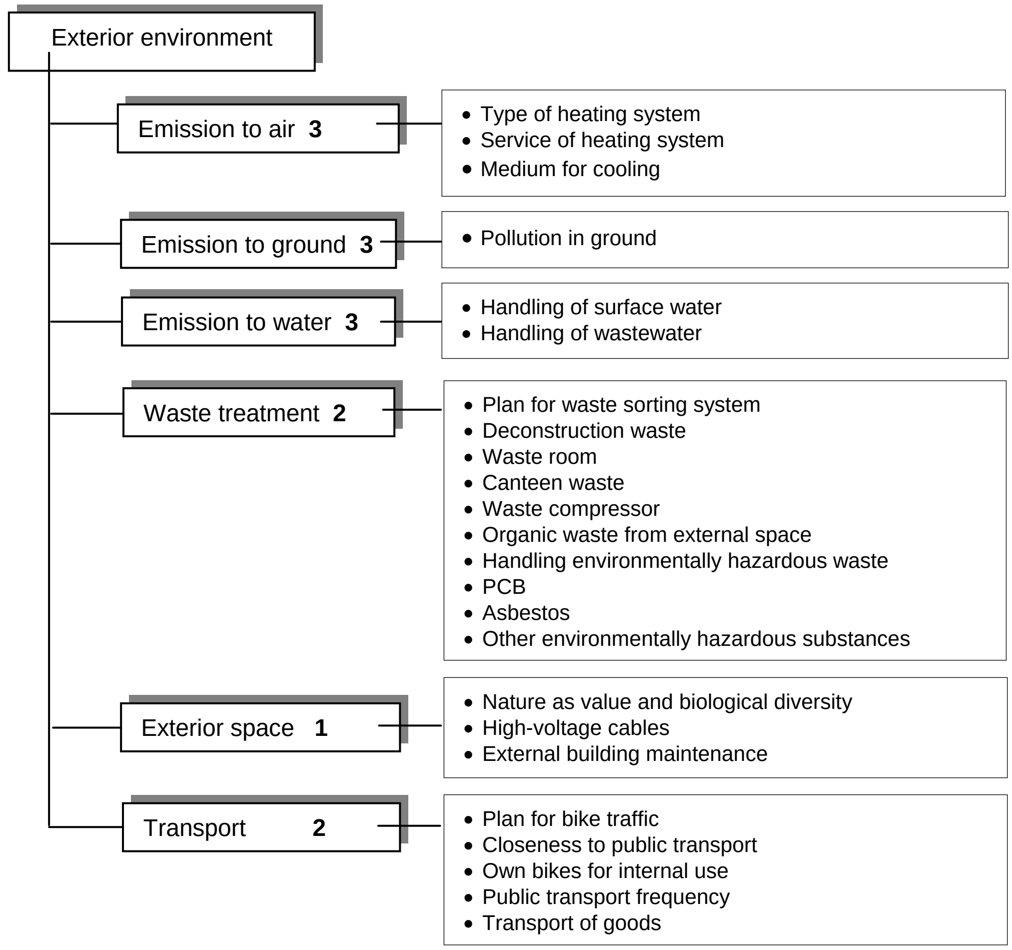


Figure 2. Parameters and weights for "Exterior environment".

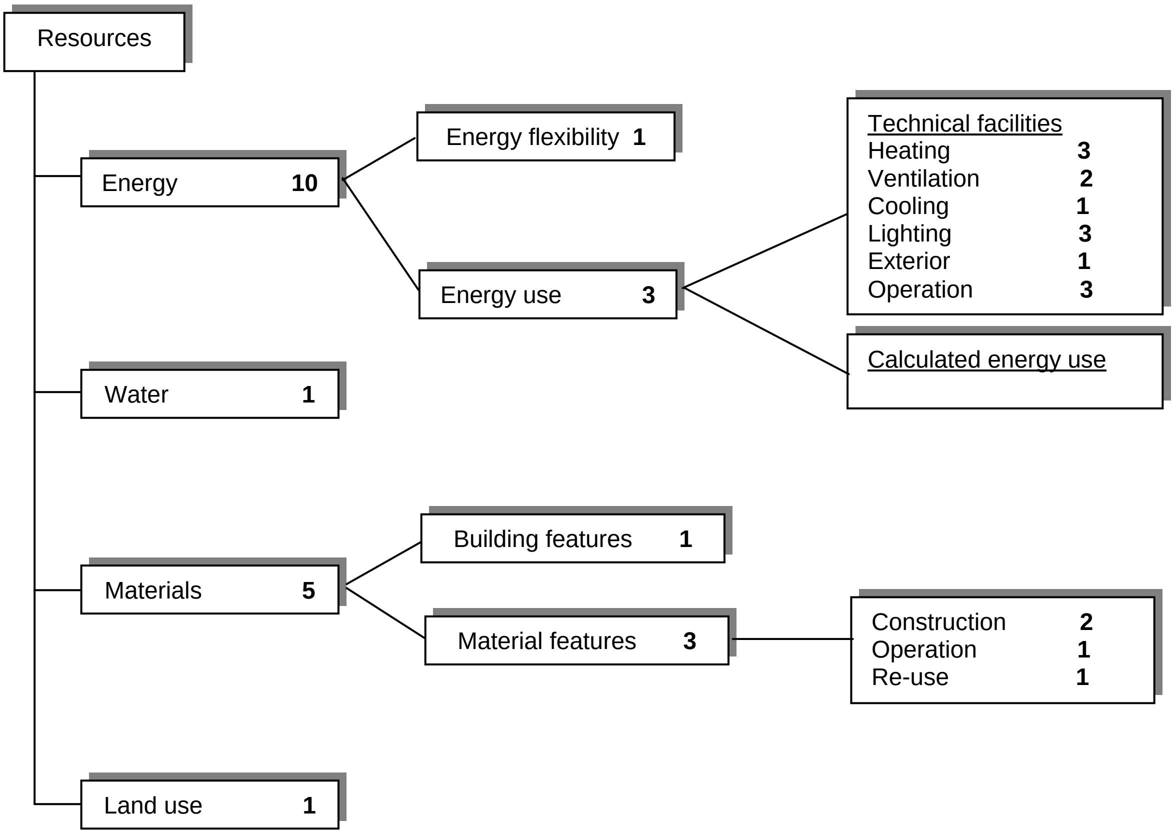


Figure 3. Parameters and weights for ”Resources”.

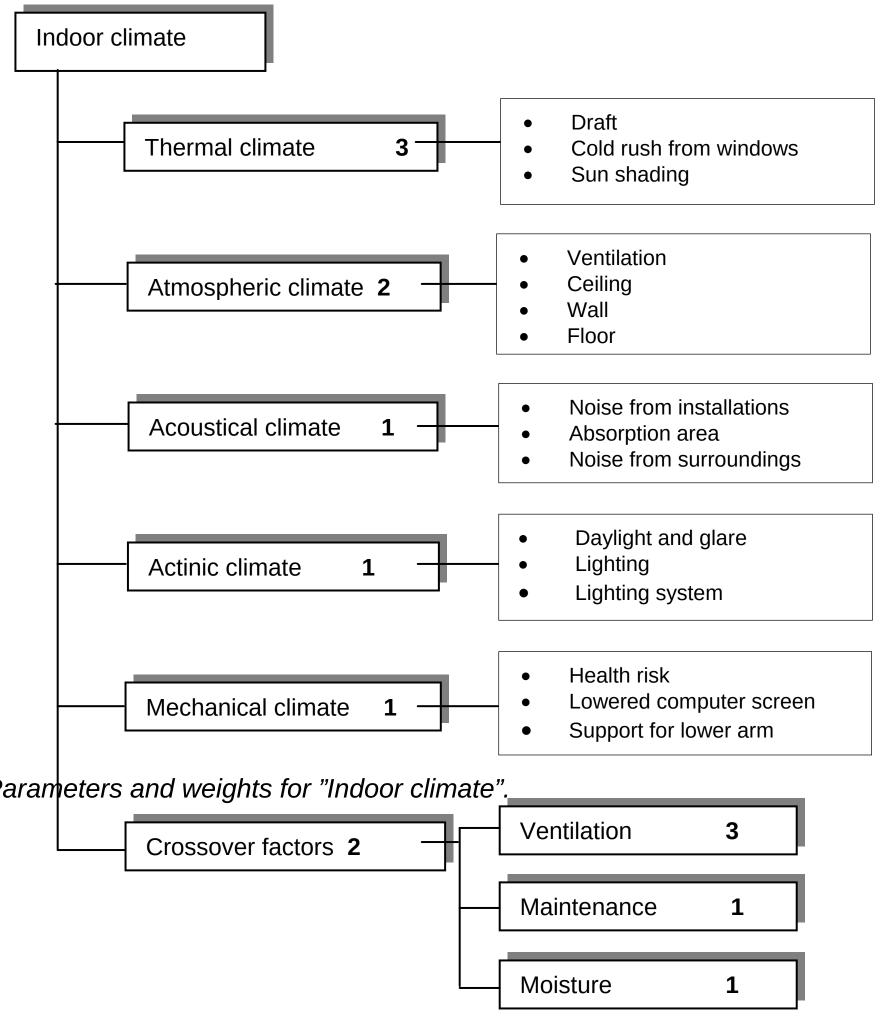


Figure 4. Parameters and weights for "Indoor climate".

4. Results of the EcoProfile assessment

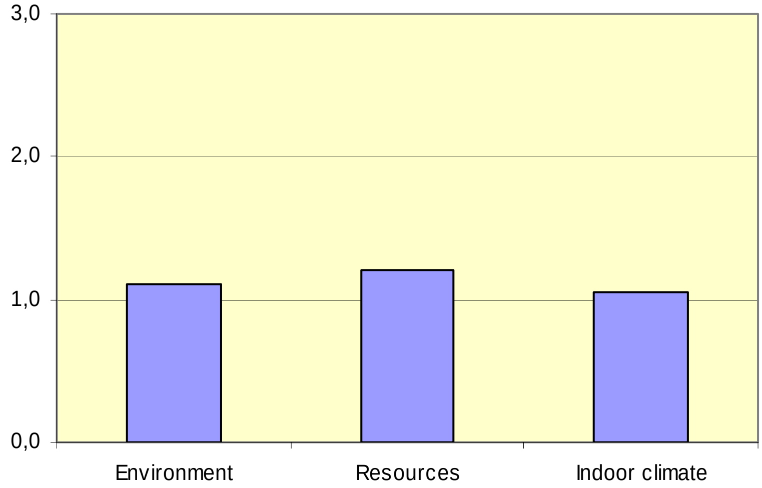
The underlying material for the assessment is listed in the forms in chapter 8 (appendix).

Figure 5 shows the results of the EcoProfile assessment of the Borgen Community Centre project. The project received level 1 scores for all the three main categories, indicating “minor environmental load”. One can look closer at the different parameters by studying the “rose”-diagrams in the Figures 6 through 8.

The ”rose” describing ”Exterior environment” in Figure 6 shows that it is merely in the category “Emissions to water” that there is a deviation from the top score. This is due to the presumption that wastewater is sent into the public wastewater treatment system and not treated directly on site, giving the score 2 in the assessment (see form in chapter 8).

The ”rose” describing ”Resources” in Figure 7 shows that the parameters ”re-use”, “material use – operation”, “material use – construction” and “water use” get scores higher than 1. For “re-use”, this is due to the fact that large sections of the walls are constructed without concern for re-use. The lower score for “material use – operation” is due to the performance of insulation materials and the roof cladding. The chosen insulation materials are mineral wool and polystyrene, both with higher energy use for production than the class 1 materials (cellulose, straw, peat etc). For “material use – construction”, the deviation from top performance is due to the medium level re-use of materials and that materials have environmentally labels and not declarations. Here it is worth mentioning that there are presently just a few products that are environmentally declared, making it almost impossible to obtain top score in this category. The reason for the score 2 for “water use” is that it is assumed that just a few of the armatures have water saving features.

The “rose” for “Indoor climate” in Figure 8 shows that it is merely “athmospheric climate” that has a reduced score from the top score. This is due to the chosen surfaces for sections of the floor, as linoleum, PVC and rubber are class 2 materials.



Explanations to the levels:

0: reserved for future definition of ”sustainability”
1: Low environmental load
2: Medium environmental load
3: High environmental load

Figure 5. Main results of the EcoProfile assessment for Borgen Community Centre. Note that the chart has a slightly altered visual appearance compared to the original EcoProfile method. The scale is chosen to give a close link between the “rose” diagrams and the final results.

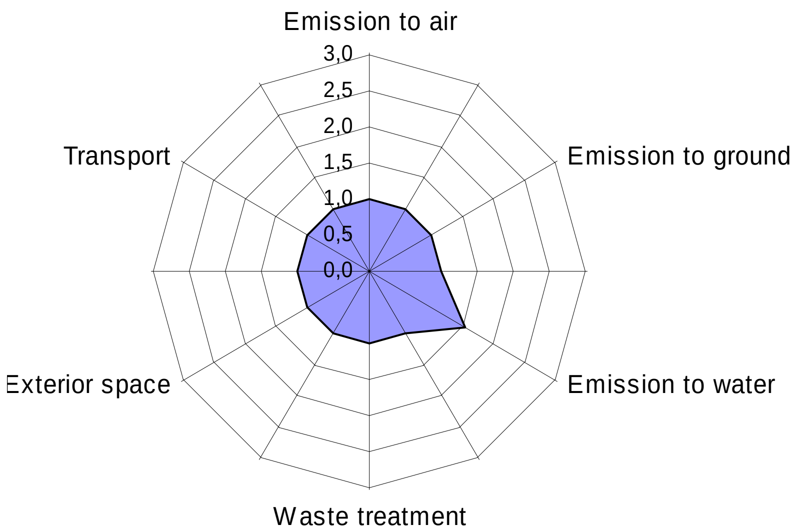


Figure 6. EcoProfile “rose” for the area “Exterior environment”.

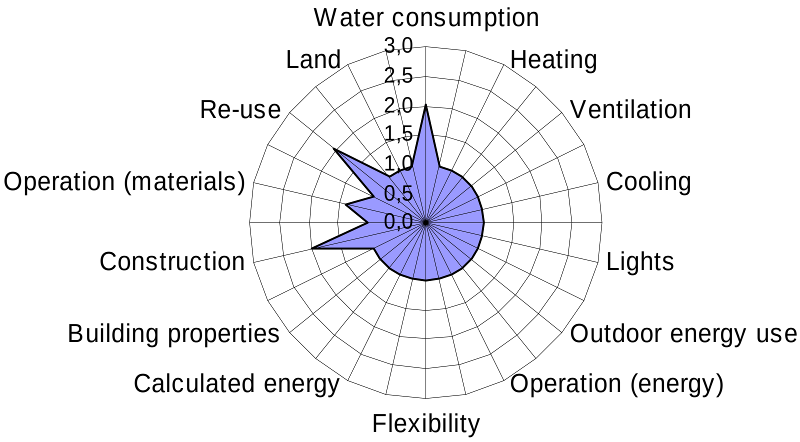


Figure 7. EcoProfile "rose" for the area "Resources". The parameters on the right side of the "rose" from heating to calculated energy use are the category "energy use" The parameters on the left side ranging from building features to re-use are for "materials".

Explanations to the levels:
0: reserved for future definition of "sustainability"
1: Low environmental load
2: Medium environmental load
3: High environmental load

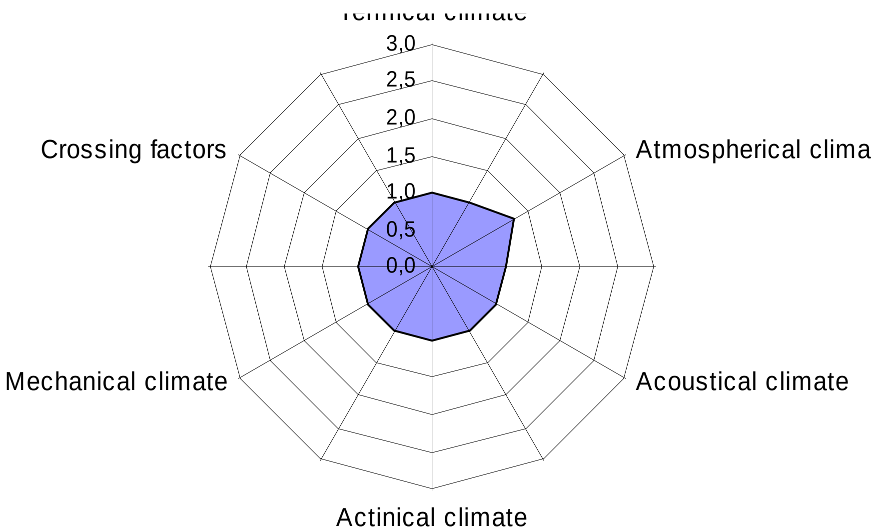


Figure 8. EcoProfile "rose" for the area "Indoor climate".

5. Discussion of the method

Since EcoProfile is limited to existing buildings, the threshold for obtaining a top rating is relatively low for some of the parameters. For instance, all new buildings would automatically fulfil the top rated insulation standard due to the building regulation code. The thresholds for achieving top ratings should in general be higher for new buildings than for existing ones. In this way, improvements and pioneer work is encouraged. In EcoProfile for existing buildings, top rate levels for some parameters are put quite high, though, like for example use of recycled and eco-certified materials.

Another aspect related to the fact that the program targets existing buildings is that several parameters are somewhat irrelevant when it comes to design of new projects. This is discussed in chapter 4 and also in the assessment forms in chapter 8. For use in the design stage, parameters like flexibility, space efficiency and adjustability should be given more weight. Likewise, parameters like waste management and building operation procedures, should be tuned down. Some parameters seem to be very detailed and it can be questioned whether they should be included in the assessment, like pipeline insulation, furniture density and roof protection for bicycles. Other parameters may lack detail and specifications for how to assess for instance flexibility, adjustability and space efficiency. When designing new buildings, special attention should be given to adaptation to local climate and site, features that are essential to how the building performs in terms of the environment during operation. In terms of energy use, a building's performance should be calculated in the design phase, showing the interconnections between the building design and different technical installations.

The weight given to the different parameters may be discussed. Daylight factors have been given low priority and detailing in EcoProfile. In a school building, the minimum levels should at least satisfy the building regulation codes for living spaces. Other parameters, like environmental pedagogical measures and green and varied exterior and interior environments should be given more weight in such projects.

As a final comment, one should be aware that the method is somewhat insufficient for evaluating unconventional solutions, like natural/hybrid ventilation systems. This is because the parameters are chosen and described with reference to conventional solutions, not necessarily being appropriate for describing the performance of unconventional solutions.

Chapter 6 contains a more thorough description of the environmentally related factors that were found to be important in the further design process.

6. Focus-list for further work

The following issues should be emphasised for an optimised environmental profile of the school building:

- *Energy use and indoor environment*

The energy- and power use of the school building should not exceed the reference values given in Table 1. Aiming for a total (gross purchased) energy use below 100 kWh/m^2/year is recommended. Excellent building energy performance level is 70 kWh/m^2/year.

Table 1. Reference values for energy- and effect use in school buildings in South Norway, inland, normative figures from ENOVA(http://www.enova.no/?itemid=990).

Reference values	**Energy budget kWh/m^2/år**	**Effect budget W/m^2**
Heating	40	30
Ventilation	27	41
Hot water	13	10
Fans & pumps	15	6
Lighting	23	14
Equipment	11	8
Cooling	0	0
Total	*129*	

It is preferable to assess the energy use in relation to the number of users and the occupancy schedule. If energy use is merely measured as load per m^2, a space effective building would have a poor performance. The problem is the lack of experience with this type of assessment, leaving the design group without reference values for their project. But as space efficiency is one of the parameters in the EcoProfile assessment, it is indirectly balanced with the energy performance.

- *Insulation and air tightness*

Insulation of exterior walls:
200 mm mineral wool in the exterior wall will give a U-value of about 0.2 W/(m^{2}K), fulfilling the requirement in the building code (0.22). The area of the exterior wall is relatively small, giving a relatively small energy gain by increasing the insulation thickness.

Insulation of the roof:
To reach the U-value level required in the building code (0.15 W/(m^{2}K)), 250 mm of mineral wool is required. The main building of the Borgen Community Centre has a large roof surface with large skylights, thus an insulation level of 300 mm of mineral wool is recommended. This gives a U-value of about 0.13 W/(m^{2}K).

Insulation of floors:
To obtain a U-value below 0.15 W/(m^{2}K), the insulation should be at least 150 mm of expanded polystyrene. To avoid thermal bridges, it is necessary to have extra insulation along the edges and exact workmanship has to be applied by edges and in the overlaps between elements, especially between floor and walls. Considering that

the existing floor slab will be kept, a high level of insulation of the floor may prove both costly and difficult. If 150 mm of insulation of the floors is impossible, one may consider a “technical switch”, using high performance windows (triple pane low-energy windows), see next point.

Windows (skylights included):
The U-value requirements in the building code for windows is 1.6 W/(m^{2}K). The main building of the Borgen Community Centre has relatively large window areas, making them a main contributor to heat loss from transmission. Several of the windows are relatively high (2 m), giving a risk of cold draft unless the glazing is well insulating or have heaters below. It is recommended to find windows with a low U-value, preferably wooden-frame windows with two or three panes with low-E coating and argon gas in the cavities. This window (size 1.2 m x 1.2 m) will have U-values of 1.2 W/(m^{2}K) with two panes and 0.9 W/(m^{2}K) with three panes.

Thermal bridges:
Carefully designed and constructed details in the exterior construction are important to avoid thermal bridges. The transitions between floors and walls are the most critical.

Air tightness:
Well made details are important to avoid unwanted air flows through the exterior constructions.

- *Control systems*

Demand controlled lighting:
It is recommended to use sensors for user presence and daylight levels on electric lighting along with low-energy bulbs and fixtures.

Demand control of ventilation:
It is recommended to use low-emission materials, displacement ventilation with CO_2-, temperature and moisture sensors. This should reduce ventilation levels to 6-7 m^3/h (compared to the usual 10-12 m^3/h in reference buildings).

Demand adjusted temperature regulation:
It is recommended to use systems for night- and holiday lowering of temperatures.

- *Heat recovery of exhaust air*

It is recommended to use an effective heat recovery system in the ventilation system, with at least 75% efficiency in mechanical systems and 55% in hybrid/natural systems.

- *Avoid cooling*

Energy for cooling should be avoided by exterior sun shading measures, utilizing the mass of heavy constructions and nocturnal cooling (free cooling) along with cooling of ventilation air in underground ducts.

- *Renewable, sustainable energy sources*

For instance heat pumps, solar energy systems or bio fuels.

- *Good daylight access*

Good daylight access and -distribution in all rooms for regular use. This is described in a separate report, see (Matusiak, 2005).

- *Avoid moisture*

Moisture is a main source for bad indoor climate. The following measures are important for avoiding moisture problems:

Details:
Design details to avoid moisture leakages (air tightness, metal fittings etc) and condensation. Check in particular corners with still-standing air and low surface temperatures and avoid thermal bridges.

Dry out constructions:
Moisture must be allowed to dry before materials and constructions are sealed with exterior finishes, floor plates etc. As an example, moisture levels in concrete floors should be lower than 85% relative moisture before finishing layers are glued on. Refer to the technical specifications of the Norwegian Building Research Institute, G474.533 and A541.304 for moisture levels and drying times.

- *Use low-emitting materials in exposed surfaces*

In Denmark and Finland, special labelling systems targeting the indoor climate have been developed (see http://www.rts.fi/emission_classification_of_building_materials.htm?49,12. and www.dsic.org). Several Norwegian manufacturers have labelled their products in Denmark and some have tested their products in Norwegian laboratories by similar methods. The effect on the indoor environment is assessed by measuring emissions and the time elapsed from mounting until emission levels have reach acceptable concentration levels in the indoor air. Particularly relevant in terms of the time/concentration levels are products like glue, grouting, paint and floor covering. In the Finnish labelling system, material emissions are separated into three categories – M1, M2 and M3, where M1 denotes the best performance. M3 materials should not be allowed. The total amount of M2 materials should not exceed 20%. Materials like bricks, ceramic tiles, stone, glass and metal surfaces are categorized as low-emitting and need not be measured.

Of the materials mentioned in the initial design project, one should particularly check the rubber floor covering and the vinyl coatings.

- *Ease of maintenance*

Use constructions and materials with smooth surfaces, few shelves and dust-gathering properties, and avoid shaggy materials like carpets.

- *Space efficiency, adaptability and accessibility*

Space efficiency:
Large buildings require a large amount of materials and energy for heating and ventilation. Space efficiency is hence an important parameter in terms of resource consumption. Evaluation of space efficiency can be done in several ways:

Calculate gross/net factor. Net area is defined as the total area excluding traffic areas, constructions, technical space and shafts. Look at use of space versus number of users.

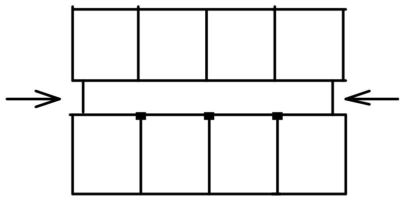
Adaptability:
Large amounts of resources are spent for refurbishing and expanding buildings. In EcoProfile, the expression "building flexibility" is used as an indicator for this aspect of sustainability. The expression describes a buildings ability to easily be adjusted to changing user needs. A more appropriate expression is "adaptability" which covers multifunctionality, flexibility, and elasticity.

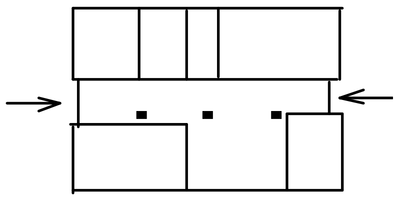
Multifunctionality means that space may suit several types of functions and users. The characteristics are:

- Open floor space
- Fixed furnishing are connected to fixed constructions
- Moveable furnishing
- High ceilings
- Abundant daylight with control devices
- Adjustable lighting (general and in points)
- Access to the different installations
- Good acoustics for both small and large groups

Flexibility means that space is planned to cope with changes in size, furnishing and equipment to accommodate different functions and users.

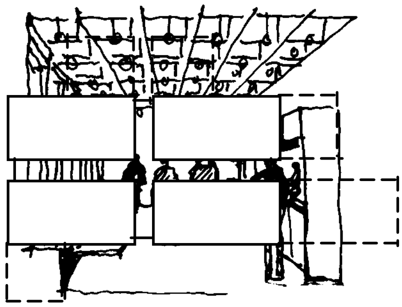
- The characteristics are:
- Column/beam construction
- Non-carrying partition walls that may be moved
- Installations available for change and upgrading
- Installations and fixed furnishings are connected to fixed constructions
- Light levels can be regulated and changed according to user needs
- Acoustic regulation
- Zone-controlled indoor climate system



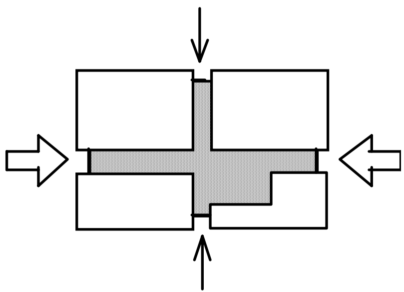


Elasticity means that space is planned to be able to expand and shrink in accordance to the shifting needs of the individual units (partitionable and extendable). The characteristics are:

- Site design incorporating possible future expansions and partitions.
- Planning of entrances and internal connections incorporating possible future changes
- Planning of constructions and installations enabling expansions, shift in functions and new partitions



Accessibility:
Planning for good accessibility for all types of users is an environmental factor that may prevent costly and resource



demanding future refurbishings and that secures effective use of the building. Good accessibility means:

- Easily readable exterior entrances
- Good internal connections
- Good accessibility for disabled users and for transport of equipment. This includes level-free access, elevators (if necessary: ramps) and sufficient space for wheelchairs in awnings and passages.

Common areas should be given the best possible accessibility, while basic areas (more “private” areas) may have a somewhat lower accessibility.

Entrances, internal connections and accessibility are basic elements in the physical attributes of the project and are contributing to the necessary elasticity for a project in constant transformation.

- *Durability, robustness and ease of maintenance*

Choose materials and solutions that have long durability, are robust (weatherproofing, resilience to use) and easy to maintain. The best solutions are often the more simple solutions with few moveable parts and material types.

- *Local, renewable resources*

Avoid use of rare, non-renewable materials and materials transported over long distances.

- *Re-use/recycling of waste from building disposals*

A plan for the building disposal process should be produced. Sorting of waste and disposal of toxic waste (PCB in windows) are examples of topics to be addressed.

- *Health- or environmentally hazardous materials*

No products containing health- or environmentally hazardous chemicals should be used. This may be checked in the A- and B lists of the authorities as well as in the OBS-list. The A- and B lists of prioritized toxins for the environment is found in the Parliamentary resolution number 58 (1996-97) Environmental politics for a sustainable development, box 6.2. The A list contains environmentally hazardous toxins that are to be considerably reduced within the year 2000 and stopped within the year 2005. Chemicals on this list should not be used. The B list contains chemicals that should be considerably reduced within 2010. Chemicals on this list should not be used unless it can be documented that there are no appropriate substitutes. The OBS-list is produced by the environmental preservation authorities and contains 250 chemicals hazardous to the health and the environment, and that may evoke problems on a national level. Use of the chemicals should be reduced in the risk of health and/or the environment. The OBS-list is found on www.mistin.dep.no (choose Tema (subject) – Kjemikalier (chemicals) – OBS-listen). Here, examples of products containing the chemicals are also given.

One should particularly pay attention to the use of paint, glue and enamel, and materials and components that contain PAH, PCN, heavy metal, halons, KFK, PCB (forbidden). Materials like PVC, polyurethane, polyamide, epoxy, melamine foam, pressure- and vacuum impregnated wood and wood protection chemicals may give negative effects on the environment.

Documentation of the environmental features of materials should be provided, and one should preferably choose environmentally labelled and -declared products.

- *Waste*

Plans for waste minimization in constructing and demolition should be produced. Also, a plan for waste management that specifies treatment of hazardous waste should be produced.

7. References

Burge, S., A. Hedge, et al. (1987). “Sick Building Syndrome: A study of 4373 office workers.” Annals of Occupational Hygiene 31: 493-504.

GRIP (1996). Økoprofil for bygg. Oslo, GRIP senter.

Hathaway, W. E. (1995). “Effects of school lighting on physical development and school performance.” Journal of Educational Resarch 88 (4).

Jesch, L. F. (1998). “The Daylit Office Environment. A Story of Energy and Productivity from the Western USA.” SunWorld Volume 22 (Number 4): 14-16.

Küller, R. and C. Lindsten (1992). “Health and behaviour of childern in classrooms with and without windows.” Journal of Environmental Psychology 12 (4): 305-318.

Nicklas, M. and G. Bailey (1996). “Daylit Students Shine Brighter.” SunWorld Volume 20 (Number 3): 13-15.

PG&E (1999). "Daylighting in schools: An investigation into the relationship between daylighting and human performance." Condensed report. San Francisco, CA, Pacific Gas and Electric Company/Heshong Mahone Group.

Matusiak, B. (2005). ”Daylighting in Borgen Community Centre.” Norwegian University of Science and Technology, Department of Design, History and Technology, Trondheim, Norway.

8. Appendix: Assessment forms for environmental parameters

"EcoProfile" for Borgen Local Environment Centre

Based on EcoProfile for commercial buildings, with adjustments mainly based on EcoProfile for dwellings

BUILDING: Borgen Local Environment Centre, School Building
ADRESS: Asker
PERFORMED BY: Inger Andresen, SINTEF Architecture and Building Technology

(grey)	. from EcoProfile Commercial buildings
(yellow)	. from EcoProfile Dwellings
(green)	: from EcoProfile with adjustments
(blue hatched)	. from EcoProfile Commercial buildings, not included in results due to low relevance

Main area "Exterior environment"

Emission to air, ground and water

1.1. EMISSION TO AIR Weight 3 Comments

1.1.1	Heating system	Electric or district heating	1	Heat pump with combined oil/electricity furnace
		Combined oil/electricity or biofuel		
		Oil		
1.1.2	Service on heating system	No heating system or documented, good maintenance routines	1	Good routines assumed. Little relevance in design phase
		Medium quality maintenance routines		
		Undocumented maintenance routines		
1.1.3	Medium for cooling	Ammoniakk, CO_2 eller Ingen kjøling	1	No cooling planned. Medium for cooling in heat pump is R134a
		HFK (R134a, HFK 152a, HFK 32, HFK 125, HFK 143 a)		
		KFK (R11, R12, R500, R502) eller HKFK (R22, R123)		
General comments				

1.2. EMISSION TO GROUND Weight 3 Comments

1.2.1	Pollutions in ground	No pollution in ground	1	Unlikely, since no industrial activity in neighbourhood
		Knowledge of pollution or of buried containers, but no knowledge of content		
		No knowledge of pollution		
General comments				

1.3. EMISSION TO WATER Weight 3 Comments

1.3.1	Handling of surface water	All surface water and drainage water is handled on site (< 30% of site area has compact surfaces, surface water is infiltrated)	1	Surface water infiltrated on site
		All surface water is sent off the site, but the site has sufficient area/permeable surfaces to handle surface water (< 30% of the site has compact surfaces, surface water is infiltrated)		
		The whole site has compact surfaces, surface water is not infiltrated, but sent off the site to the public network		
1.3.2	Handling of wastewater	Some local ecological purification below the critical level of recipients		
		All wastewater to public network	2	
		Local emission below the critical level of the recipients		
General comments				

Main area "Exterior environment"

Waste treatment and environmentally hazardous substances

1.4. WASTE TREATMENT, HEALTH- AND ENVIRON

			Weight	2	Comments
1.4.1	Plan for waste sorting system	Yes, sorting in 4+D144 fractions		1	Assumed
		Yes, sorting of paper or organical waste			
		No source sorting of waste			
1.4.2	Deconstruction waste	Re-use of deconstruction waste		1	Focus on maximising re-use of deconstruction waste
		Re-use of interior walls			
		All to public waste dump			
1.4.3	Waste room	Own waste room		1	It is assumed that waste is stored in a way that the usersof the building is screened from botheringsmell, noise or other discomfort.Sorted waste is stored in indoor lockers and in external source sorting containers placed in sheds
		Waste room combined with other functions			
		No waste room			
1.4.4	Canteen waste	Use of canteen waste to animal food/compost		1	Irrelevant to design phase
		No source sorting or use of canteen waste			
1.4.5	Use of nonce-use articles	Minimal use of nonce-articles		1	Assumed. Irrelevant to design phase
		Some use of nonce-articles			
		Extensive use of nonce-articles			
1.4.6	Waste compressor	Own compressor for paper and remainder waste		1	Irrelevant to design phase
		Compressor merely for paper			
		No			
1.4.7	Organic waste from external space	Compost on site		1	
		Delivery of compost other place			
		To public waste dump			
1.4.8	Handling environmentally hazardous waste	Routines for registering and handling hazardous waste		1	Assumed. Irrelevant to design phase
		Merely routines for registering hazardous waste			
		No routines for registering or handling hazardous waste			
1.4.9	PCB	No PCB-containing materials used		1	Assumed
		Some PCB-containing materials used			
		(PCB-amount < 1000 g)			
1.4.10	Asbestos	No materials containing asbestos		1	Assumed
		Some materials containing asbestos (building materials or technical equipment)			
		Substantial amounts of materials containing asbestos or no overview			
1.4.11	Other environmentally hazardous substances	Minimal content of hazardous substances in the building		1	Assumed. Attention on glue, enamel and paint
		Some content of hazardous substances in the building			
		Large content of hazardous substances in the building or no overview			
General comments					

1.5. EXTERNAL SPACE Weight 1 Comments

1.5.1	Nature as value and biological diversity	More than 50% of the area is green. Vegetation in several stratums and with more than 50% old trees. Main part of vegetation is natural species for the area	1	
		Ca. 50% of the area is green. Few trees, bushes dominate. Mainly imported species		
		More than 50% of the area is covered with asphalt or other hard surfaces. Minimal green elements		
1.5.2	High-voltage cables	No high-voltage cables	1	More than 100 m to high-voltage cables
		Distance to high-voltage cables is over 50 m		
1.5.3	External building maintenance	Good maintenance	1	Easy maintenance with good access
		Medium maintenance		
		Poor maintenance		
General comments				

1.6. TRANSPORT Weight 2 Comments

1.6.1	Plan for bike traffic	Bike parking under roof	1	Irrelevant
		Rigidly mounted bike stand		
		Poor or no bike parking		
1.6.2	Closeness to public transport	< 5 min. walk to stop or private bus	1	
		5-15 min. walk to stop		
		> 15 min. walk to stop		
1.6.3	Own bikes for internal use	Yes	1	Irrelevant to design phase
		No		
1.6.4	Public transport frequency	At leat 8 departures (all directions) per hour	1	External conditions
		2 – 8 departures (all directions) per hour		
		Less than 2 departures (all directions) per hour		
1.6.5	Transport of goods	Own access road with screened ramp	1	
		By main entrance on own site		
		Parking in street, delivery to main entrance		
General comments				

Main area "Resources"

2.1 Water use

Weight 1

2.1.1. Water use

Weight 1

				Comments
2.1.2	Water saving equipment	Yes, in the whole building		Shower with time control
		Yes, some places	2	
		No		
General comments				

2.2 Energy

Weight 10

2.2.1 Energy use

Weight 3

2.2.1.1. HEATING

Weight 3

				Comments
2.2.1.1.1	Insulation of walls/floors/ceilings	Better than BF-87	1	
		According to BF-87 U = 0,3/0,2/0,2W/m²K		
		Poorer BF-87		
2.2.1.1.2	U-values windows	U=1,6 W/m²K or better	1	
		U=1,6-2,6 W/m²K		
		U=2,6 W/m²K or poorer		
2.2.1.1.3	Tap water	Combined with central heating+own container	1	Served by heat pump
		Own water heater		
		Combined with furnace system without own container		
2.2.1.1.4	Furnace/vvx condition (efficiency)	Annual efficiency η > 90 %	1	Combined oil/electricity
		Annual efficiency 90 % < η < 80 %		
		Annual efficiency η < 80 % or not documented		
2.2.1.1.5	Pipe insulation	Good	1	
		Medium		
		Poor		
2.2.1.1.6	Regulation of heating	Demand controlled of temperature (compensation to exterior+local thermostat)	1	
		Compensation to exterior		
		Manual control		
2.2.1.1.7	Termostatic valves	Yes	1	
		No		
2.2.1.1.8	Nicht/vacation set-back of temperatures	Demand controlled regulation of temperature (compensation to exterior+local thermostat)	1	
		Timer based control		
		No		
2.2.1.1.9	Regulation of space temperatures	Electronical thermostat in each room	1	
		Zoning		
		Mechanical thermostat on each heater or no thermostat		
General comments				

2.2.1.2. VENTILATION

Weight 3

				Comments
2.2.1.2.2	Heat recovery	Rotating/x-exchanger η > 70-80% or heat pump	1	Heat recovery of ventilation air, > 50 % on hybrid system+pre-heating in duct, >70% on mechanical system. In addition heating of ventilation air with heat pump
		Battery/heatpipe η > 50%		
		No		
2.2.1.2.3	Time dependant control	Centralised control system	1	
		Diurnal/weekly timer		
		Continuous operation		
2.2.1.2.4	Insulation of pipes/canals	Good	1	
		Medium		
		Poor		
General comments				

2.2.1.3. COOLING

Weight 1

				Comments
2.2.1.3.1	Interlocking	Yes	1	Simultaneous heating/cooling avoided through central control system
		No		
2.2.1.3.2	Sunshading to south/east/west	External	1	
		Internal		
		None		
2.2.1.3.3	Free-cooling	Intelligent automatic	1	Cooling controlled by SD-system
		Automatic		
		Manual		
2.2.1.3.4	Regulation of cooling	Modulating	1	
		Several steps		
		On/off		
General comments				

2.2.1.4. LIGHTING Weight 3 Comments

2.2.1.4.1	Offices/common areas	Energy efficient lights with electronic ballasts, up-lights	1	
		Energy efficient lights, reflective armatures and screens		
		Old bulb types, incandescent, etc.		
2.2.1.4.2	Lighting regulation	Automatic	1	Occupancy and daylight sensors
		Manual routines		
		No routines		
General comments				

2.2.1.5. EXTERNAL ENERGY USE Weight 1 Comments

2.2.1.5.1	External lighting	Low energy with photocell or none	1	Low energy bulb with photocell
		Lighting with photocell		
		No control		
2.2.1.5.2	External heat cables	Yes, with thermostat and moisture control or no heat cables	1	Assumed no exterior heat cables
		Yes, with thermostat control		
		Yes, with on/off control		
General comments				

2.2.1.6. OPERATION Weight 3 Comments

2.2.1.6.1	Training of operation personell	Yes, frequent training and technical updating	1	Assumed
		Some		
		Little		
2.2.1.6.2	Maintenance instructions	Yes, complete with user guidance and descriptions	1	Assumed
		Partial, mainly brochures		
		Missing		
2.2.1.6.3	Maintenance routines	Set routines	1	Assumed
		Some		
		No		
2.2.1.6.4	Service contracts	Yes, on all installations	1	Assumed
		Partial or only on ventilation		
		No		
2.2.1.6.5	Energy surveilance system, EOS	Yes	1	
		No		
General comments				

2.2.2. ENERGY FLEKSIBILITY Weight 1 Comments

2.2.2	Energy flexibility	Central heating with two sources	1	Heat pump, electricity and oil
		Central heating with one source		
		Electrical system energy/effect controlled through SD-system		
		Electrical system with top load guard		
		Electrical system without control		
General comments				

Main area "Resources"

R-m MATERIALS

Weight 5

R-m.1 BUILDING FEATURES

Weight 1

				Comments
R-m.1.1	Building flexibility	Yes	1	Light interior walls, large ceiling height/few ceilings. Easy to change partitions in space in the home-bases
		Partial		
		No		
R-m.1.2	Planning for handicapped	Yes	1	Elevator, wide corridors and passages, HC toilets
		No, but possible wit adjustment		
		No, and difficult to adjust		
R-m.1.3	Space efficiency	Yes	1	High level of common use of space, areas also used after school hours. Gros/net factor=1,4: norm for new schools, good for refurbished schools, though much is deconstructed
		Partial		
		No		
General comments				

R-m.2 MATERIAL FEATURES

Weight 3

R-m.2.1 BYGGING Weight 2

				Comments
R-m.2.1.1	Re-used materials	High share		Bottom tie plate + columns and beams are kept. Re-use of brick
		Medium share	2	
		Low share or no information		
R-m.2.1.2	Environmentally labelled materials	Environmentally labelled materials		Only a few building materials in the market are environmentally labelled
		Environmentally declared materials	2	
		No environmental documentation for materials		
General comments				

Main area "Resources"

Materials

R-m.2.2 **OPERATION** (maintenance and lifetime plu

			Weight	1	Comments
R-m.2.2.1	External cladding	Little environmental load		1	Brick - long lifetime, little maintenance
		Medium environmental load			
		Large environmental load			
R-m.2.2.2	Insulation	Little environmental load			Mainly mineral wool, some polystyrene: medium production load
		Medium environmental load		2	
		Large environmental load			
R-m.2.2.3	Windows	Little environmental load		1	Wooden frames with aluminum cladding
		Medium environmental load			
		Large environmental load			
R-m.2.2.4	Roof cladding	Little environmental load			Flat roof has asphalt cardboard cladding. Tilted roof has PVC film.
		Medium environmental load		2	
		Large environmental load			
R-m.2.2.5	Floor cladding	Little environmental load		1	Polishes concrete floor, impregrated and waxed. Linoleum and/or rubber. Wooden floor+some vinyl
		Medium environmental load			
		Large environmental load			
General comments					

R-m.2.3 **RE-USE**

			Weight	1	Comments
R-m.2.3.1	Framework building	Suitable for re-use			Prefabricated hollow concrete elements. Steel gridbeams. On-site carrying walls in basement. - Framework building not designed with focus on dismountability
		Suitable for material/energy recycling		2	
		Suited for deposit			
R-m.2.3.2	External cladding	Suitable for re-use			Brick with cement-based mortar
		Suitable for material/energy recycling		2	
		Suited for deposit			
R-m.2.3.3	Internal walls	Suitable for re-use			Sack-scrubbed brick in common areas and storage rooms, wardrobes etc Glass walls to the students workrooms +library and teachers work zones. On-site constructed plaster walls in areas with heavy use
		Suitable for material/energy recycling		2	
		Suited for deposit			
R-m.2.3.4	Roof cladding	Suitable for re-use			Flat roof has asphalt cardboard cladding. Tilted roof has PVC film.
		Suitable for material/energy recycling		2	
		Suited for deposit			
General comments					

Main area "Resources"

R-I LAND

Weight **1**

				Comments
R-I.1.1	Site utilization	Good space utilization	1	Good indicators are missing. Evaluated by judgement
		Medium space utilization		
		Poor space utilization		
R-I.1.2	Roads, access	Little road use	1	Little traffic, sober road standards
		Medium road use		
		Large road use		
R-I.1.3	Parking	No parking, parking under street leverl or outside pressure areas	1	Outside pressure areas
		Parking in multi-storey facilities or on streety level with p-cover factor ≤ 70 %		
		Parking on street level with p-cover factor ≤ 70 %		
R-I.1.4	Biological diversity	Appurtenant areas have varied and multi-strated vegetation connected to larger green areas	1	
		Appurtenant areas have varied and multi-strated vegetation		
		Appurtenant areas have little variation in vegetation		
General comments				

Main area "Interior climate"

3.1 TERMICAL CLIMATE

			Weight 3	Comments
I.1.1	Draft	Possibilites for pre-heated supply air, no local draft from leaks	1	
		No pre-heated supply air, no local draft from leaks		
		No pre-heated supply air, some local draft from leaks		
I.1.2	Cold rush from windows	Good windows combined with functioning oven supply	1	3 layer windows with 2 lowE coatings and argon filling
		Poor windows combined with functioning oven supply		
		Poor windows combined with small supply from oven under window		
I.1.1	Shading from unfavourable solar radiation	External	1	External blinds
		Internal		
		None		
General comments				

3.2 ATMOSPHERICAL CLIMATE

			Weight 3	Comments
I.2.1	Ventilation	Balanced ventilation or other possibility for pre-heating ventilation air	1	Pre-heating of ventilation air in ducts
		Sufficient number of vents, possibility for air-purging		
		Merely slit-ventiles, no possibility for air-purging		
I.2.2	Ceiling	Enamelled wooden panel, metal, painted concrete, plaster, cellulose boards	1	Dust-bound concrete in ceilings. Most rooms without suspended ceilings. Mainly sufaces with low emission levels
		Painted chipboard/wooden fibre board		
		Textile ceiling		
I.2.3	Wall	Glass, enamel coated wooden panel, tiles/ceramics, unpainted brick, paper wallpaper	1	Unpainted brick, glass - materials with low/no emission
		Vinyle wallpaper/laminate, painted concrete/plaster/brick, plaster with/without glass fibre		
		Textile wallpaper		
I.2.4	Floor	Enamel coated wooden floor, tiles/ceramics/stone, terazzo		Polished, impregnated and waxed concrete. Linoleum and PVC. Rubber (check) Some wooden floors.B426
		Linoleum, vinyl/PVC, oil/lye/painted wooden floor	2	
		Carpets/rubber		
Generelle kommentarer				

Main area "Interior climate"

3.3 ACOUSTICAL CLIMATE

Weight 2

				Comments
3.3.1	Noise from technical installation	< 30 dBA	1	Assumed
		=< 35 dBA		
		> 35 dBA		
3.3.2	Absorption area ceiling	Cell office: > 20 %	1	
		Cell office: 1-20 %		
		Cell office: 0 %		
		Landscape office/classroom: > 50 %	1	Uncertain measures. To be checked by expert
		Landscape office/classroom: 20-50 %		
		Landscape office/classroom: < 20 %		
3.3.3	Noise from surroundings	Hear no voices	1	
		Hear voices, but no recognition of content		
		Hear and comprehend voices/conversations		
General comments				

3.4 ACTINICAL CLIMATE

Weight 1

				Comments (more importance?)
3.4.1	Daylight/dazzling	Distance to window < 4 m from workplace + full screening possible	1	Good access to daylight(skylights, tall windows). Possibility for screening glare with curtains and exterior blinds
		Distance to window is 4 - 10 m or partial/no screening possibilities		
		No exterior view > 10 m from window		
3.4.2	Lighting	Good general lighting + work space lighting	1	Good general lighting in classrooms, workspace lighting in offices
		Good general lighting but no work space lighting		
		Bad general lighting or merely work space lighting		
3.4.3	Lighting system	Lighting with fully automatic interlock	1	
		Lighting without automatic interlock		
General comments				

3.5 MECHANICAL CLIMATE

Weight 1

				Comments
3.5.1	Health risk	Furniture density < 50 %	1	Is this representing relevant hazard risk in school buildings? Regarded irrelevant
		Furniture density 50 - 70 %		
		Furniture density > 70 %		
	Lowered computer screen	Yes (most)		Assumed. Irrelevent for design phase
		Some	2	
		No (few or no)		
	Support for lower arm	Yes (most)	1	Assumed. Irrelevent for design phase
		Some		
		No (few or no)		
General comments				

Main area "Interior climate"

3.6 CROSSING FACTORS **Weight 3**

3.6.1 Ventilation Weight 1 Comments

	Regulated with documentation	Balance better than ± 10 %	1	Assumed executed as dictated. Irrelevant for design phase
		Balance between ± 10 % and ± 20 %		
		No documentation or lower than ± 20 %		
	Placement of air-intake	On roof or 10 m > over ground plus > 30 m from cooling tower	1	Intake for mechanical system on roof, air intake duct about 4 m above ground
		< 3 m over ground on facade plus > 10 m from cooling tower		
		< 3 m over ground on facade or > 10 m from cooling tower		
	Final filter/supply air	EU8 or better	1	EU8
		EU7		
		Poorer than EU7		
	Transfer outlet/supply air	Minimum 20 m as the crow flies or 10 m in broken line	1	Assumed executed as dictated. Irrelevant for design phase
		Minimum 10 m as the crow flies or 5 m in broken line		
		< 10 m as the crow flies or < 5 m in broken line		
	% dustcover, aggr.	< 3 %	1	Assumed that aggregate and ducts are regularily cleaned
		3 - 5 %		
		> 5 %		

General comments

These parameters are generally dealing with air quality and should belong under 3.2 Atmospherical climate.

3.6.2 Maintenance Weight 1 Comments

	Shelf factor*	< 0,2	1	Assumed. (Total shelf length in meters divided by space volume)
		0,2 – 0,3		
		> 0,3		
	Shaggyness factor**	< 0,4	1	Assumed (area shaggy surfaces - carpets, curtains, textile furniture - divided by space volume)
		0,4 – 0,6		
		> 0,6		
	Ceiling	No suspended ceiling or compact ceiling	1	Most rooms are without suspended ceilings. Wood fibre boards used as acoustical element - can be vaacumcleaned
		Whole but perforated ceiling		
		Ceiling raft		

* Shelf factor = total meters of open shelves divided by space volume (for closer description, see parameter description in Ecoprofile for commercial buildings)
** Shaggyness factor = area of shaggy surfaces (carpets, curtains, textile furniture) divided by space volume

3.6.3 Fukt Weight 1 Comments

	Waterdamage-proof pipes	Pipe-in-pipe system	1	
		Open		
		Closed		