Symposium

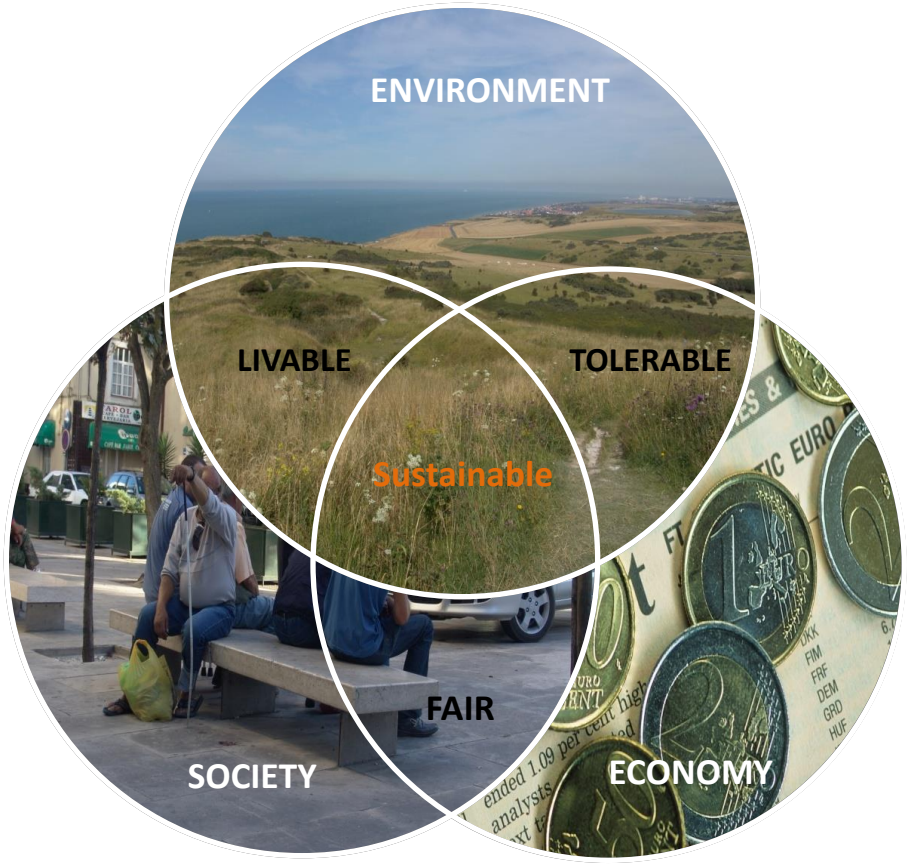
Renovation of Non-Residential Buildings towards Sustainable Standards

Exhibition « Light + Buildings 2014 – 3 April 2014

Subtask D: Environmental and Health Assessment Sustainable Refurbishement of school Buildings

Sophie Trachte, Architecture et Climat, University of Louvain la Neuve, Belgium

What means Sustainable Development?



Sustainable Development
=

Development that meets present needs without compromising the ability of future generations to meet their

Construction Sector in Europe

Building sector in Europe - **25 billions of square meters built**

- 25% are non residential buildings
- 40% were built before 1960 (old stock!)

Building sector in Europe – **Environmental impact**

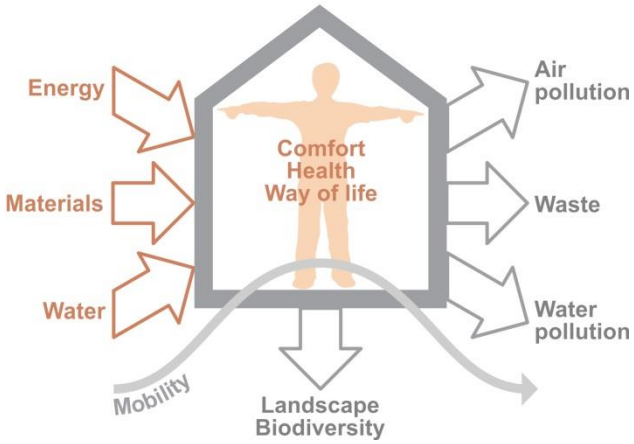
- 40 % of total natural resources depletion;
- 40 % of total energy consumption;
- 35 % of total waste production;
- 40 % of total greenhouse gas emission;
- 15 % of total water consumption;

Source: European Conference On Sustainable Renovation Of Buildings (2012)

Old buildings do not offer comfort and quality of life expected by users.

Renovation is a real opportunity to improve comfort while lowering environmental impact of buildings and reducing fossil energy cnsumption

What means Sustainable Refurbishment?



Sustainable Refurbishment

=

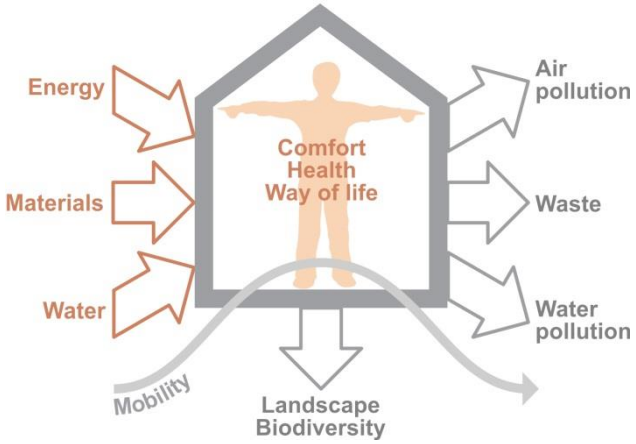
Reduction of Energy requirements

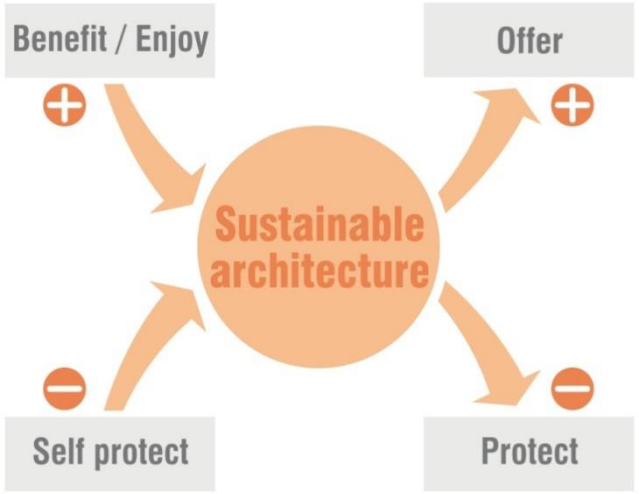
+

Holistic and global WORK
on buildings and surroundings

To be considered as «**sustainable**», the renovation process must also correspond to the global concept defined by the Rio declaration (1992) and the 27 principles drafted in application of the definition of sustainable development proposed by Gro Harlem Brundtland.

What means Sustainable Refurbishment?





To be considered as «**sustainable**», the refurbishment process must also **interact strongly** with the various **contexts (environmental, social, economic, ...)** in which it is integrated, while:

- ➔ Benefiting from the advantages of those contexts
- ➔ Protecting against aggressions from those contexts
- ➔ Giving the benefit of sustainable improvements to those contexts:
- ➔ Protecting those contexts from the environmental, economical and social nuisances of the construction itself

School Buildings in Europe




School

=

openness to the world,
learning and knowledge
socialization practices



School Buildings in Europe

To play this role, schools must offer quality and comfortable places of learning and teaching. This is not the case in Europe:

- ➔ Old or outdated buildings
- ➔ Poorly insulated
- ➔ No heating regulation
- ➔ Ventilation system: absent or not effective
- ➔ Outdoor spaces and playgrounds without real quality, too small, too noisy

This state of discomfort has **negative consequences on pupils concentration and their learning process (20 to 30%)**

School = building with specificities

School buildings have very different characteristics compared to office buildings or office buildings:

➔ Occupancy rate relatively low

Schools are, most of the time, occupied 4 to 5 days per week, from 8:00 am to 15/16h00 pm.
School buildings are used about 200 days per year with relatively long periods of non-occupancy.

➔ Number of occupants relatively significant

According to the OECD report, the average number of students per class

- in primary education is **22**
- in secondary education is **24** but there may be large variations between countries .

Average surface : 2.27 to 3.63m² per pupil (office building : 12/15 m²)

➔ Diversity of occupants and needs

Adults and childrens
Childrens from 2,5 to 18/19 years old

School = building with specificities

School buildings have very different characteristics compared to office buildings or office buildings:

➔ Diversity of rooms and spaces, large surface to be treated





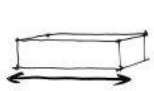
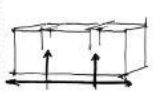
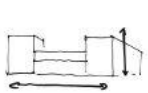
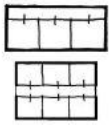
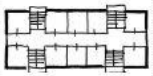

➔ Importance of outdoor spaces



School = building with specificities

School buildings have very different characteristics compared to office buildings or office buildings:

➔ **Diversity of building types, construction methods and materials used**

Horizontal - Low	Horizontal - High	Centered	Vertical	Mixed
				
Less than 4 floors Longitudinal extension 1 main vertical access axe Classrooms arranged either on one or both sides of the corridor	More than 4 floors Longitudinal extension More than 1 main vertical access axe Classrooms are arranged either on one or both sides of the corridor	Up to 3-4 floors 2 or more axis horizontally No clear preferential extension Atriums surrounded by the building structures	More than 4 floors Vertical extension-vertical access axes ("core") Classrooms are arranged around this "core"	Composition of elements from previous categories Possibly one dominating category In any case separated treatment necessary
	Contrary to horizontal lower buildings it needs differentiated attention due to fire precaution, escape routes and used materials.		In any case the vertical building category needs differentiated attention due to fire precaution, escape routes and used materials.	
				

School building, 1968, AT [AEE INTEC]

School building, 1958, CH [FHNW]

School building, 1930, BE [Passiefhuis-Platform vzw]

School building, 1970, DE [Google street view]

Priorities for Sustainable Refurbishment of School Buildings

1. Increasing the comfort, the well-being and the quality of life

- **Improving thermal comfort, visual comfort, acoustical comfort, indoor air quality;**

  Envelope and building performances must be improved:
  - Optimising volume and compactness
  - Optimising insulation and airthightness
  - Reducing thermal bridges
  - Optimising glazed surfaces
  - Optimising solar protection
  - Limiting overheating – inertia
  - Limiting overheating – natural intensive ventilation
  - Optimising acoustic insulation and correction (classroom)
  - Limiting indoor pollution
  - Optimising ventilation system

- **Improving quality of life, especially in cities and urban context:**
  - Collective spaces, green spaces and playground
  - Soft mobility
  - Accessibility
  - Social diversity
  - Social interactions

Priorities for Sustainable Refurbishment of School Buildings

2. Reducing the consumption of fossil energy resources

It is urgent to consume LESS WELL AND OTHERWISE taking into account of

- *operation energy for the use of buildings*
- *embodied energy of building materials*
- *energy for transportation of occupants/users*

Priorities for school buildings:

- Heating system + regulation
- Ventilation system + regulation
- Artificial Lighting + regulation/control

- Improving the performances of the buildings envelope (priority 1);
- **Optimizing the systems (heating, ventilation, artificial lighting)**
  - Optimising heating system
  - Optimising hot water production
  - Optimising ventilation system
  - Optimising artificial lighting
- **Increasing the onsite renewable energy production**
  - Hot water production by solar thermal
  - Electricity generation from renewable sources
  - Heat pump in renovation

Priorities for Sustainable Refurbishment of School Buildings

3. Enriching stoks of natural resources, including water

- **Enriching the "water" resource**
  - Reducing water consumption
  - Recovering and using rainwater if it is possible
  - Allowing the infiltration of rainwater into the ground;

- **Enriching land and raw materials resources**
  - Rational use of land and spaces
  - Rational use of building materials;

- **Enhancing biodiversity**
  - protection, conservation and creation of green spaces
  - Creation of green roofs

Priorities for Sustainable Refurbishment of School Buildings

4. Reducing waste production, including waste water

- Recycling or purifying waste water
  - Extensive techniques (by plants)
  - Intensive or mechanical techniques

- Limiting and managing production of construction waste
  - Preventive measures
  - Managing construction waste and exploiting stocks from recycling of waste;
  - Waste management on building site

- Controling and managing production of operation (domestic) waste
  - Reducing waste at source – pedagogical choice
  - Managing and making rational use of operation waste

Environmental assessment methods

The integration of these four priorities in professional practice is a necessary step to achieve sustainable building renovation. These priorities are also the “red line” of the different environmental assessment methods such as **BREEAM** (England), **LEED** (US), **HQE** (France), **DGNB** (Germany), **Total Quality Building** (Austria)...

ÖGNB
Österreichische Gesellschaft für Nachhaltiges Bauen
klima:aktiv

www.ibo.at

U.S. GREEN BUILDING COUNCIL
LEED
USGBC

www.usgbc.org/**LEED**

HQE
ASSOCIATION
www.assohqe.org

www.assohqe.org

MINERGIE-ECO®
MINERGIE-P-ECO®

www.minergie.ch

BREEAM®

www.breeam.org

DGNB
Deutsche Gesellschaft für Nachhaltiges Bauen e.V.
German Sustainable Building Council

www.dgnb.de

Valideo

www.valideo.org

BREEAM assessment methods

BREEAM®

Table 21-1: BREEAM assessment issues by building type and their percentage contribution to BREEAM performance

		Office	Retail	Industrial	Healthcare	Primary School	Secondary school	Further Education	Higher Education	Prisons	Courts	Multi-residential	Other buildings
Management													
Man 01	Sustainable procurement	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%
Man 02	Responsible construction practices	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%
Man 03	Construction site impacts	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%
Man 04	Stakeholder participation	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%
Man 05	Service life planning and costing	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
Health & Wellbeing													
Hea 01	Visual comfort	2.8%	3.5%	2.8%	4.2%	2.6%	2.6%	2.8%	2.8%	2.8%	2.8%	2.5%	2.8%
Hea 02	Indoor air quality	5.6%	5.3%	5.6%	5.0%	5.3%	5.3%	5.6%	5.6%	5.6%	5.6%	5.0%	5.6%
Hea 03	Thermal comfort	1.9%	1.8%	1.9%	1.7%	1.8%	1.8%	1.9%	1.9%	1.9%	1.9%	1.7%	1.9%
Hea 04	Water quality	0.9%	0.9%	0.9%	0.8%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.8%	0.9%
Hea 05	Acoustic performance	1.9%	1.8%	1.9%	1.7%	2.6%	2.6%	1.9%	1.9%	1.9%	1.9%	3.3%	1.9%
Hea 06	Safety and security	1.9%	1.8%	1.9%	1.7%	1.8%	1.8%	1.9%	1.9%	1.9%	1.9%	1.7%	1.9%
Energy													
Ene 01	Reduction of CO_2 emissions	8.1%	9.5%	8.1%	8.1%	8.4%	8.4%	8.1%	8.1%	8.1%	9.8%	9.8%	9.5%
Ene 02	Energy monitoring	1.1%	1.3%	1.1%	1.1%	0.6%	0.6%	1.1%	1.1%	1.1%	0.7%	0.7%	0.6%
Ene 03	Energy efficient external	0.5%	0.6%	0.5%	0.5%	0.6%	0.6%	0.5%	0.5%	0.5%	0.7%	0.7%	0.6%

12%

15%

19%

Subtask D focuses on school renovation

BREEAM assessment methods

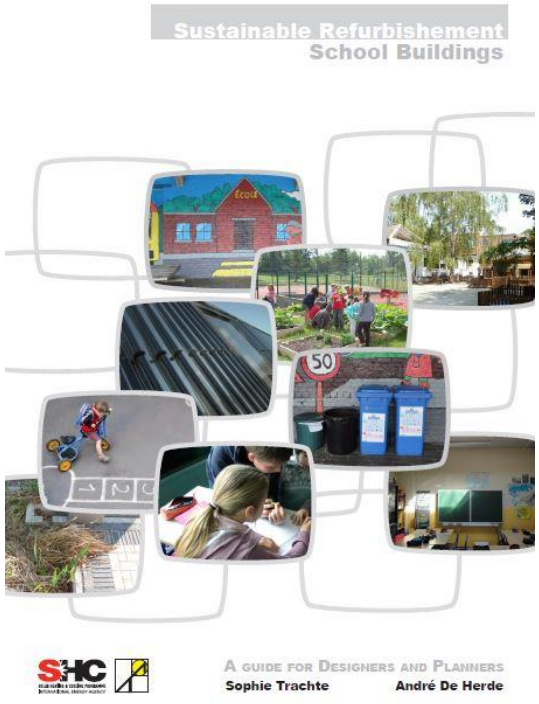
BREEAM®

		Office	Retail	Industrial	Healthcare	Primary School	Secondary school	Further Education	Higher Education	Prisons	Courts	Multi-residential	Other buildings
	lighting												
Ene 04	Low or zero carbon technologies	2.7%	3.2%	2.7%	2.7%	2.8%	2.8%	2.7%	2.7%	2.7%	3.3%	3.3%	3.2%
Ene 05	Energy efficient cold storage	1.6%	1.9%	1.6%	1.6%	1.7%	1.7%	1.6%	1.6%	1.6%	2.0%	2.0%	1.9%
Ene 06	Energy efficient transportation systems	1.1%	1.3%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.3%	1.3%	1.3%
Ene 07	Energy efficient laboratory systems	2.7%	0.0%	2.7%	2.7%	2.8%	2.8%	2.7%	2.7%	2.7%	0.0%	0.0%	0.0%
Ene 08	Energy efficient equipment (process)	1.1%	1.3%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.3%	1.3%	1.3%
Ene 09	Drying space	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%
Transport													
Tra 01	Public transport accessibility	2.7%	4.4%	2.7%	4.0%	3.4%	3.4%	3.6%	3.6%	4.0%	4.4%	2.7%	3.6%
Tra 02	Proximity to amenities	0.9%	0.9%	0.9%	0.8%	1.1%	1.1%	0.7%	0.7%	0.0%	0.9%	1.8%	0.7%
Tra 03	Cyclist facilities	1.8%	1.8%	1.8%	1.6%	2.3%	2.3%	1.5%	1.5%	2.0%	1.8%	0.9%	1.5%
Tra 04	Maximum car parking capacity	1.8%	0.0%	1.8%	0.8%	0.0%	0.0%	1.5%	1.5%	0.0%	0.0%	1.8%	1.5%
Tra 05	Travel plan	0.9%	0.9%	0.9%	0.8%	1.1%	1.1%	0.7%	0.7%	2.0%	0.9%	0.9%	0.7%
Water													
Wat 01	Water consumption	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%
Wat 02	Water monitoring	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
Wat 03	Water leak detection	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%

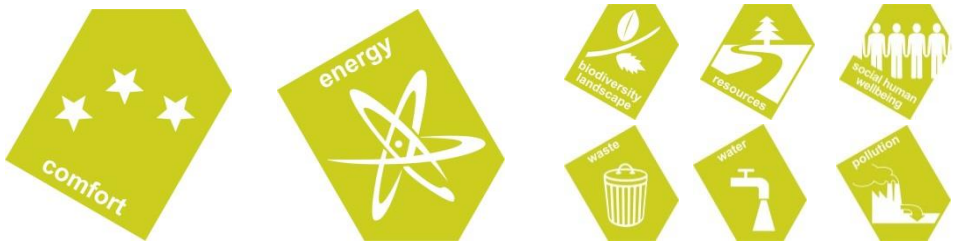
8%

6%

RESULT : A guidebook for designers and planners



- School renovation = common objective for european countries
- **Holistic approach** based on environmental, urban infrastructure, comfort and health



- **Guidelines to be followed in the design phase and during renovation works**
- Sufficient knowledges and tools **adapted to professional practice**
- **Illustrated by exemplary projects from Subtask A**

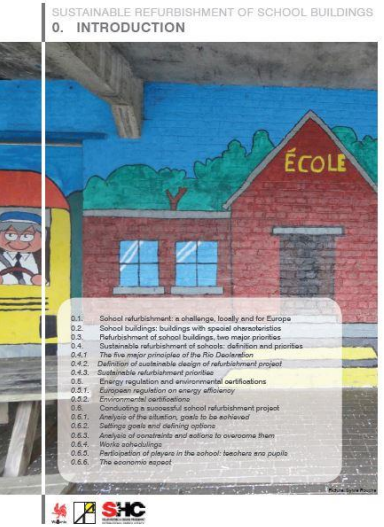
RESULT : A guidebook for designers and planners

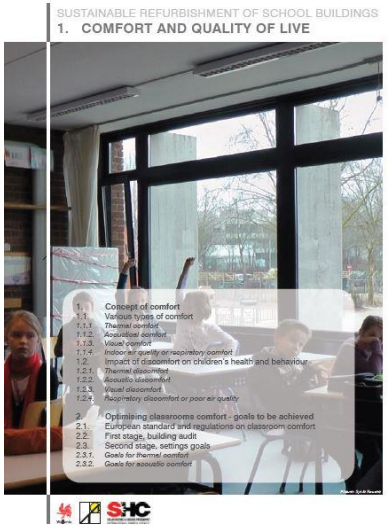
An introduction

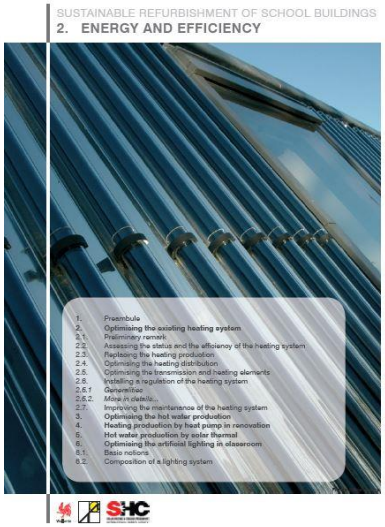
4 priorities = 4 chapters

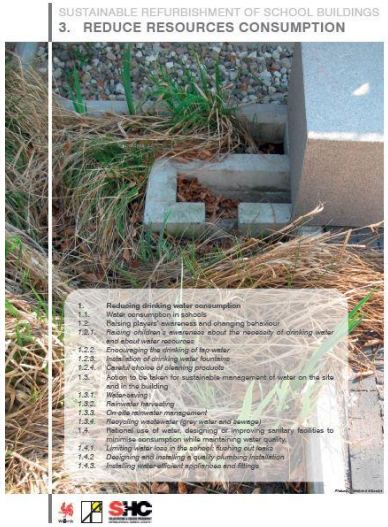
In each chapter:

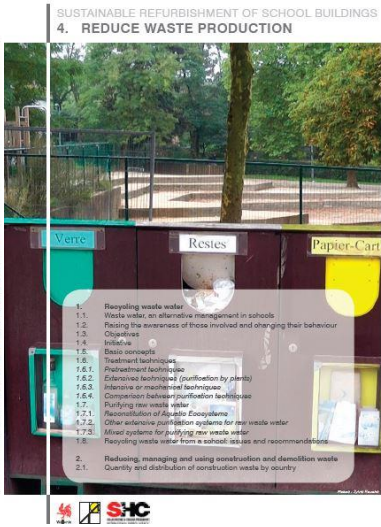
- Theorical basics
- Proposals and tools to identify and evaluate problems met in buildings
- Solutions and recommandations
- Links with BREEAM certification











Thank you for your kind attention

Any questions?

Architecture et Climat
www-climat.arch.ucl.ac.be
sophie.trachte@uclouvain.be