

Short version profile plan for Energy in Urban Development 2015–2019

Vision

The vision of the profile Energy in Urban Development is to:

- Contribute to reaching a global sustainable development with a primary focus on urban developments.
- Utilize and further develop cutting-edge applied research and demonstrator projects on single and multi-building scale.
- Facilitate meeting points for knowledge sharing between Chalmers researchers, public authorities, and businesses active on the local, national and global arena.

Background and context

The building sector is an important facet of the influence on global warming, contributing about 30–40 % of anthropogenic greenhouse gas emission (UNEP 2003, IPCC 2014). Most reports agree that there is significant potential for reducing greenhouse gas emission from improvements of the energy efficiency of buildings.

In the European Union, buildings use more energy than industry, and most of the energy for heating and electricity generation comes from fossil fuels. One measure towards energy sustainability is the legislation on nearly zero-energy buildings (nZEB) enforced from 2019 for public buildings.

In Sweden, buildings already use energy from non-fossil fuels to a very large extent. However, improving the energy efficiency of the Swedish building stock means that low carbon electricity can be exported and replace fossil electricity in other countries.

On our regional arena, Västra Götalandsregionen aims at becoming a fossil-free region by 2030. One prioritised area is efficient energy use in dwellings and commercial buildings. Thus, there is potential to develop the profile from a regional perspective as well as from a Swedish and EU perspective.

Many research projects have demonstrated that energy efficient refurbishment of single buildings is often challenging regarding the return on investment. This leads to a situation where energy efficient refurbishments are not happening neither in scale nor time for achieving national and international energy and climate goals. However, it has been shown that there is a large potential to achieve the goals when extending the system boundaries, by considering the energy supply systems and the energy management together with the energy demand side. This advanced perspective demands trans- and interdisciplinary projects, new competences and solutions, but offers large economic, societal, and environmental benefits.

The profile Energy in Urban Development main focuses are on single building scale where the interaction between design of new buildings, the refurbishment of existing buildings and their energy supply for heating, cooling, and electricity are important, as well as the management on the multi building scale up to the city level.

Active fields

The Energy in Urban Development profile has three active research fields:

- Indoor Environmental Quality (IEQ)
- Energy on Single Building Scale
- Energy on Multi Building Scale

Within these fields, Chalmers has a strong potential to achieve excellence.

Indoor Environmental Quality

Indoor environmental quality had a strong position at Chalmers in the 1990's. After some years of lower interest in the area, Chalmers now has unique possibilities to take national lead in this area and develop a national node as we still have access to or contact with major research institutes, authorities, organisations, and companies within this area. Chalmers also has a unique laboratory facility with test rigs, chambers and a room with an advanced heating, ventilating, and air conditioning (HVAC) system.

Energy on Single Building Scale

Research in this field deals with design of buildings using novel and advanced materials, components and systems. The research targets refurbishment of old buildings (built before 1950) and of less old buildings, as well as new state-of-the-art nearly zero-energy buildings. On a national level, Chalmers has a unique composition of senior researchers in the areas of building physics, building materials, and building services engineering. By combining these research areas with the possibilities created by the HSB Living Lab now being constructed on Chalmers campus, new and deeper collaborations with stakeholders, industry and international research groups are foreseen.

Energy on Multi Building Scale

Research in this field targets larger energy systems, from a global level down to the district and neighbourhood level. The aim is to analyse how smart and energy efficient technologies can provide solutions to current and future challenges in the fields of use of building services, mobility and traffic, education, and security of supply. The interplay between the energy system and the existing building stock is of major importance including future development pathways. We analyse how to, by tackling the problem at the neighbourhood/district level, finding solutions that speed up the transition, and by taking into account both the energy demand, the supply-side as well as the energy management.

Planned activities 2015–2019

The Energy in Urban Development profile is rather young, and large effort will be spent on developing the profile further. In fact, one of the initial work packages for the period is dedicated to profile development:

- **Profile development (2015–)**

The work package aims at better understanding the already existing activities and projects and the people driving these processes. This will allow the profile to sharpen its strategy on how to become one of the leading players in Europe and globally in the energy-related discussion on urban developments.

In addition, the profile has planned the following four work packages:

- **National research school (2015–)**

The aim is to develop a national framework for PhD students in the form of a national research school on “Building System Design and Performance” within the framework of the Swedish Universities of the Built Environment (Sveriges Bygguniversitet, SBU). A steering committee will develop and manage regular PhD seminars and courses, and form a reference group among stakeholders.

- **Indoor environmental quality (2015–)**

In this work package we aim to develop research related to requirements on thermal comfort, indoor air quality, acoustics, and daylight and their influence on energy use. This will be achieved by development of a research agenda, establishment of contacts and R&D project initiation networks, for example active participation in the IEA Annex 69 Strategy and Practice of Adaptive Thermal Comfort in Low Energy Buildings.

- **Renovation for energy efficiency (2015–)**

This work package strives to stimulate, coordinate, conduct and evaluate activities to increase the energy performance of buildings, settlements/districts or entire cities. This work package tries to bring together the energy supply and the energy demand side as well as the energy management perspective. Planned activities are among others related to calls for state of the art research projects or other topic related actions as well as the participation in the IEA Annex 70 Building Energy Epidemiology: Analysis of Real Building Energy Use at Scale.

- **Thermal energy storage solutions (2016–)**

Research on materials, components and systems for thermal energy storage (TES) systems has been going on at Chalmers for many years. However, the challenge is to utilise the TES solutions to their full potential also in full-scale applications. The aim of this work package is to continue, and further develop, our ongoing work by the development of a broader research agenda. Both new types of TES solutions as well as extended collaborations are required such as participation in the IEA Annex 30 Thermal Energy Storage for Cost Effective Energy Management and CO₂ Mitigation.