Carbon-neutral Arctic construction based on tradition

Rapid climate change poses a challenge to Arctic construction practices. Globally, buildings and construction account for more than one third of all greenhouse gas emissions. The sector consumes around half of all global raw materials that humans extract from nature.

In the Arctic, high heating demands and long transportation distances can lead to a big carbon footprint during the building's life cycle. The built environment and construction methods in the Arctic have received very little attention from researchers. The Zero Arctic project provides research-based statements for carbon neutral, resilient and sustainable Arctic construction with special reference to tradition, vernacular architecture and collaboration with Indigenous peoples and local communities.

During the Finnish chairmanship of the Arctic Council (2017-2019), Finland and Canada introduced the two-year-project Zero Arctic – carbon neutral Arctic construction based on tradition. The aim of the project was to find out how various applications of traditional knowledge in Arctic construction have supported the environmental sustainability of buildings and how these principles can be applied in the development of modern construction.

The project consisted of case studies from northern Finland, Canada (Nunavik) and Japan (Hokkaido). Each case study consisted of a survey of traditional and Indigenous dwellings, of structural solutions and settlements, and a review of the energy consumption of the existing building stock in the region. Both Finland and Canada designed case houses and assessed their climate impacts over the buildings' full life cycle using a standardized Life Cycle Assessment method. The Japanese research group assessed an existing building and constructed a historical Indigenous dwelling Chise and measured its thermal environment.

There is no single solution for all Arctic regions. The built environments in the Arctic have a big variation, with cities and rural areas facing very different challenges. The project highlights the importance of understanding local traditions and cultural aspects of living when designing sustainable buildings in Arctic regions.

FOR MORE INFORMATION:
Jennifer Spence, SDWG Executive Secretary
secretariat@sdwg.org
sdwg.org/zeroarctic
RECOMMENDATIONS FROM THE ZERO ARCTIC PROJECT TO ARCTIC MINISTERS

FOCUS ON THE FULL LIFE CYCLE IMPACTS
This is an overarching goal that should be met when pursuing the following objectives.

SET OPTIMAL ENERGY EFFICIENCY TARGETS FOR NEW BUILDINGS
Energy efficiency, though an important metric, should never be pursued at the expense of potential service life or air quality. If it is expected that the operational energy during a building’s life cycle is produced by burning fossil fuels, improving energy efficiency is even more essential. However, it is important to examine the full life cycle impacts of buildings and energy efficiency should be considered also as a question of long service life, recoverability and reusability.

INCLUDE RENEWABLE ENERGY IN THE MICRO-GRID MIX
Renewable energy sources (e.g. solar, geothermal, wind, hydro) play a major role in the carbon footprint of buildings. Solar collectors are a good source of energy, although they are limited by the seasonal imbalance in solar conditions and storage technology. Geothermal can be an excellent solution even in Arctic conditions when it uses electricity produced with renewables. On a regional level, investments in cleaner energy (wind and hydro) have a major impact on the greenhouse gas emissions related to buildings. New energy production should be planned with respect to the needs of Indigenous peoples and local communities.

PREFER LIGHTWEIGHT, LOW-CARBON MATERIALS, SUCH AS WOOD FROM SUSTAINABLY GROWN FORESTS
Wood is the only material that can compensate for the emissions from construction and use. However, to reach the full benefit, the wooden materials should not be burned at the end of the building’s life cycle, but reused as much as possible.

DESIGN BUILDINGS TO ENABLE DECONSTRUCTION, REASSEMBLY AND REUSE
Buildings can be designed in a way that the whole structure could be moved to another location. This is possible for example in traditional log construction. The buildings and the parts from which they are constructed should be designed for a long life cycle so that reassembling and reuse is possible. Considering the melting permafrost, relocating buildings might be an important issue to consider in Arctic areas in the future.

DESIGN BUILDINGS FOR CLIMATE RESILIENCE
Adjustability and easy maintenance should be pursued as a response to changing weather conditions. This may include the use of low technology, simple tools for maintenance, and dwelling operations that can be easily adjusted in response to unexpected, rapid and extreme weather and seasonal changes.

CONSIDER OCCUPANTS’ NEEDS AND PROFILES IN THE DESIGN AND OPERATION OF THE BUILDING
Involving the inhabitants (for example an Inuit community in the Canadian case) in the design process of houses and conducting post-occupancy surveys to understand how they feel about topics such as energy efficiency and maintenance contributes to the sustainability of Arctic buildings.

Zero Arctic was a consortium project led by the Ministry of the Environment (Finland) together with Crown-Indigenous Relations and Northern Affairs (Canada) and a group of experts and researchers at Aalto-University (Finland), Livady Architects (Finland), VTT Technical Research Centre of Finland Ltd, Université Laval (Canada) and Hokkaido University (Japan). The project coordination and Finnish case study were funded by the Ministry of Foreign Affairs in Finland.