NREL
Transforming ENERGY

Growing Insulation in Alaska

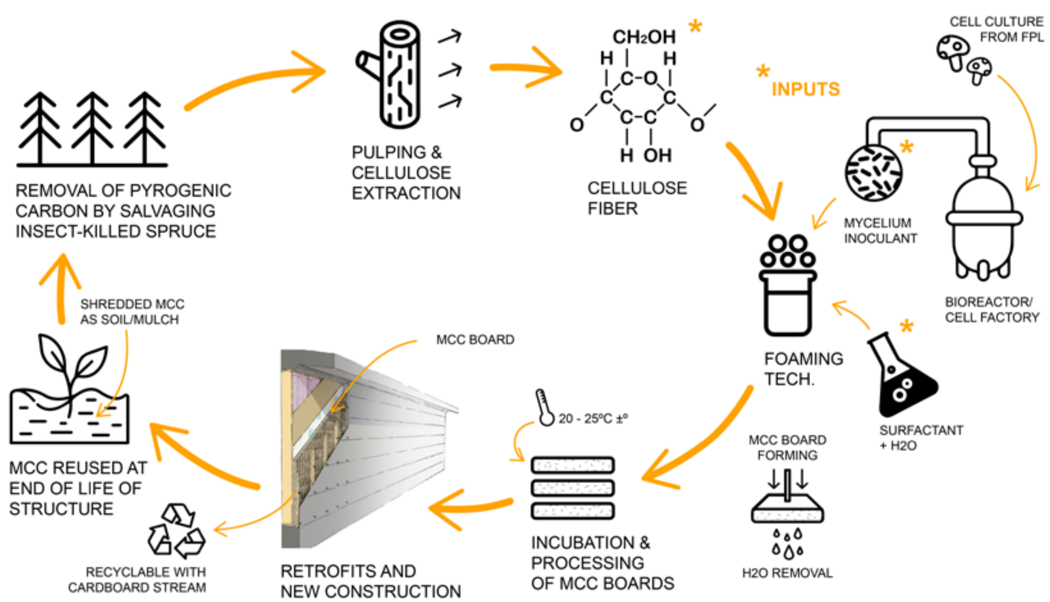
Buildings produce 40% of all carbon emissions in the U.S. This includes the energy needed to heat, cool, and power the nation's buildings and the energy used to manufacture, ship, and assemble the construction materials. In extreme climates and remote regions, buildings use even more energy, as building materials must be produced and shipped farther to the site, increasing the greenhouse gas emissions embodied in the buildings.

The U.S. National Renewable Energy Laboratory (NREL) is developing technologies that reduce how much energy our buildings use and how much carbon goes into them in the first place. NREL researchers teamed up with the Biomaterials Laboratory at the University of Alaska, U.S. Forest Service Forest Products Lab, and the VTT Centre of Finland on a three-year project to "grow" insulation using trees in Alaska–improving the efficiency of buildings by providing envelope retrofit options using local resources.

The team was recently awarded $2.47 million from the U.S. Department of Energy Advanced Research Projects Agency-Energy (ARPA-E) to continue six years of research into developing insulation from foamed cellulose and mycelium–the root network of fungi. In this process, cellulose from beetle-killed spruce trees is ground into a slurry and then foamed. That mixture is inoculated with mycelium and then incubated while the mycelium grows and binds it together. The mycelium feeds off the cellulose fibers to form a dense matrix. When that living mixture has grown into a sheet of insulative material, the researchers stop its growth by drying it. The resultant insulation provides long-term carbon storage, turning buildings from carbon emitters to sinks.

The goal of this project is to develop modular, portable units that produce carbon-sequestrating insulation on-site by harvesting local trees, thus reducing carbon, creating jobs, lowering shipping costs, and mitigating the fire risk of dead trees.

Partners: University of Alaska Anchorage; Cold Climate Housing Research Center, Inc.; Forest Products Lab; VTT Technical Research Centre of Finland



Top: Researcher Robbin Garber-Slaght with samples of insulation grown from mycelium and cellulose. Left: The circular process of producing insulation from insect-killed trees to construct carbon-neutral buildings. *Photo by Molly Rettig, NREL; Illustration by Milena Coakley, NREL*

Beetle-Killed Spruce

Southcentral Alaska, has up to 1.6 million acres of dead spruce.

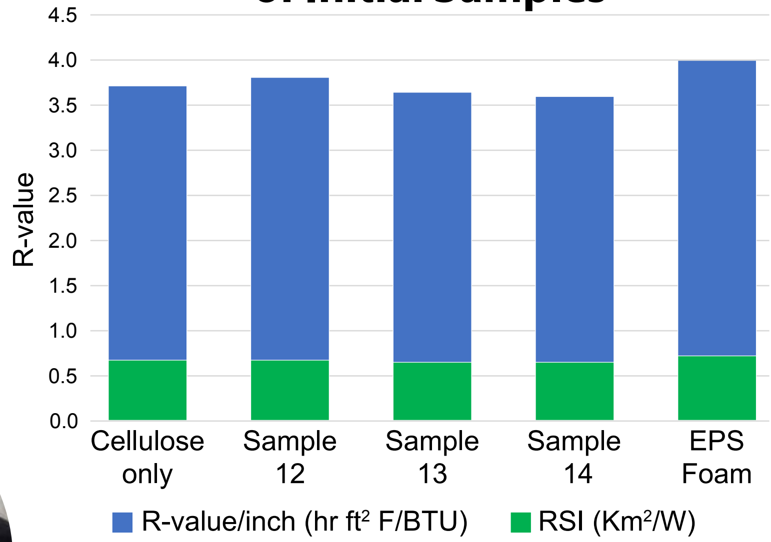
Harvested Trees

Trees are debarked and converted to chips locally.

Pulp Development

Chips are processed into pulp on-site

Thermal Performance of Initial Samples



Foaming and Innoculation

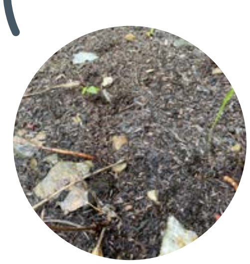
Pulp is combined with water and surfactant and mixed into a foam; Mycelium inoculant is added just before mixing is complete.

Growth

The composite grows for 5-7 days. Final boards have an R-value of ~3.7.

Market

Locally grown and harvested insulation can be used in new and retrofit construction.



End of Life

The composite becomes mulch, which can be returned to the earth.

Photo credits: Beetle Killed Spruce photo from C. Garber-Slaght; Harvested Trees photo from N. Beckage, University of Alaska Anchorage; Chips photo (to the right) from J. Zhu, USDA Forest Products Lab; Pulp Development photo from J. Zhu, USDA Forest Products Lab; Foaming and Inoculation photos from P. Amstislvaski, University of Alaska Anchorage; Molding photos from P. Amstislvaski, University of Alaska Anchorage; Growth, photos from P. Amstislvaski, University of Alaska Anchorage; Market, photo from Cold Climate Housing Research Center, Inc.; End of life photo from R. Garber-Slaght, NREL

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NREL/FS-5600-85490 • October 2023