

# SAIL

noun: an object extended on a mast in such a way as to transmit the force of the wind into power.

verb: a voyage, as in moving toward a renewable energy future.

**Artist Team:** Andrew Jepson-Sullivan, Grayson Morris

**Artist Location:** Eugene (OR), USA

**Energy Technologies:** aeroelastic flutter (Windbelt™)

Refshaleøen historically provided a space for industrial processes forced to the urban periphery, specifically the energy-intensive process of shipbuilding. SAIL is juxtaposed against this industrial past, a graceful and iconic art installation that generates utility-scale power rather than consuming it.

SAIL projects prominently from the west corner of the former shipyard into the prevailing wind, providing an elegant symbol of clean energy for the city of Copenhagen. The form recalls the shipbuilding past of the harbor, transforming from the rigid cup of a ship's hull to the graceful, unfurled surface of an open sail. A curled base results in limited ground-level impact, while the open face at the crest maximizes surface area for wind collection through the use of Windbelt™ technology.

SAIL pushes the vertical limits of the site, rising 122 meters (400 ft.) into the air. As the tallest structure on Refshaleøen, and a prominent object on the Copenhagen skyline, SAIL becomes a highly visible representation of Denmark's ambitious voyage toward the 2020 energy goals and a renewable energy future.

The installation is constructed of approximately 6975 aluminum frames, each containing 20 Windbelts™. These components are assembled into an array that faces the prevailing winds on site, supported by steel beams. The 139,500 Windbelts™ will generate an estimated 602,604 kWh annually, enough to power 135 homes.

The site at Refshaleøen has been left almost entirely undisturbed, allowing for large gatherings and events to happen with SAIL acting as a visual backdrop. Visitors to the site are invited to "enter the wind" at the apex of the tower, becoming part of the energy infrastructure that powers the city.

As night falls, SAIL produces a bright, fluctuating spectacle. Each Windbelt™ membrane on SAIL is coated with a thin OLED (organic light-emitting diode) layer that glows when the membrane oscillates in response to the wind. OLEDs can be printed onto flexible and transparent substrates, making the membrane of the Windbelt™ an ideal surface. The OLEDs fluctuate in brightness depending on how much power is being generated by each individual membrane, resulting in a shimmering light display that reflects how much power is being produced by the entire structure in real-time.

SAIL's luminous Windbelt™ membranes can be programmed to playfully celebrate significant cultural occasions, civic holidays, and important events. Through this mechanism, SAIL becomes more than just an art installation for Refshaleøen, but an icon for the entire city of Copenhagen.

## ENVIRONMENTAL IMPACT

### 1. A Small Footprint:

The dimensions at the base of the structure are 31 meters (100') by 24.5 meters (80') resulting in a minimal on-site footprint. SAIL lowers the global environmental impact of energy production in Denmark by helping to achieve the country's 2020 goal of consistently generating 50% of energy from wind power, as well as the 2050 goal of covering Denmark's entire energy supply through renewable energy generation.

### 2. De-constructability and Reuse:

Modular construction allows for Windbelt™ technology to be re-scaled and its application to be flexible. SAIL brings recognition to an innovative technology that is advancing in its application and energy output efficiency. SAIL's modular nature would allow for the structure to be deconstructed and reassembled throughout the city as part of a dispersed renewable energy network, allowing the art to live on even after the site has been redeveloped.

### 3. Recycled Materials:

SAIL employs recycled metals and other materials when possible. When necessary for the safety of visitors and the longevity of the installation materials will be used that justify a higher embodied energy. The project aims to close local material loops, using recycled materials provided by nearby recycling plants.

### 4. Inexpensive Components:

Each individual Windbelt™ frame is inexpensively produced. Materials consist of readily available and inexpensive components, and include: mechanisms to rectify and boost AC power, Mylar coated taffeta, magnets, copper coils, and lightweight aluminum housings. The units are inexpensively crafted with a low embodied energy in comparison to other renewable energy options. The composition of numerous belts allows for the simple and inexpensive replacement of parts. The OLED-printed membranes aid in maintenance: inoperative Windbelts appear as dead pixels in a night sky, helping to locate them for repair.