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Blowin' in the Wind

The giant wind turbines that help power California aren't as tough as they look. Gusty winds can actually disrupt the operation of wind turbines, break their blades or even shut them down.

Like most mechanical systems, wind turbines are designed to work best in design conditions. When conditions change—as with deceleration or acceleration of wind—efficiency suffers.

At SDSU, mechanical engineering professor Asfaw Beyene, Ph.D., has built a morphing wind turbine blade, whose aerodynamic profile changes according to prevailing wind conditions. A California Energy Comission grant supported Beyene's development of blades that twist and bend to match wind conditions.

"We have proven the feasibility of flexible blades in our test lab," Beyene said. "The next step will be to design, build and test a larger model."

In 2008, the Department of Energy and six major turbine manufacturers pledged to create "the roadmap necessary to achieve 20 percent wind energy by 2030."

Though California may have the capacity to generate 20 percent of energy from wind farms, less than 3 percent of the state's power currently derives from this source, Beyene said.

More than 90 percent of California's wind-generating capacity and output are located in three regions, according to the California Energy Commission. They are: Altamont Pass, east of San Francisco; Tehachapi, southeast of Bakersfield; and San Gorgonio, near Palm Springs.

Beyene's airfoil-shaped morphing blades improve the efficiency and maneuverability of wind turbines much as blade flaps or ailerons improve the operation of aircrafts at velocities other than cruising speed.

The concept comes from nature, specifically from Beyene's observation of fish in an aquarium. "In flying and swimming creatures, the geometries of movement morph to adapt to a flow condition," Beyene said. "We are moving from rigid geometry to a more fluid geometry that takes account of movement."