COOL BREEZE: A new analysis reveals that at the wind farm at San Gorgonio pass, pictured here, the turbines warm surface temperatures at night and cool them by day. Image: Wikimedia Commons

The giant wind turbines cropping up on ridges, shorelines and other windy locales across the world affect more than the wind—they are also changing local temperatures, notes a new study. That's likely because the enormous blades chop up the incoming wind and thereby more thoroughly mix different layers of the atmosphere. According to temperature readings from one of the oldest wind farms in the U.S., near Palm Springs, Calif., the turbines make it warmer at night and cooler during the day, generally speaking.

"For most regions, the mean temperatures may not change by much because the warming and cooling effects may cancel out," says atmospheric scientist Somnath Baidya Roy of the University of Illinois at Urbana-Champaign, co-author of the study published online October 4 in Proceedings of the National Academy of Sciences. "Wind power is on the verge of an explosive growth. It features prominently in the future energy policy of all industrial economies. Hence, we have a unique opportunity to solve a problem even before it becomes a major issue."

Roy and his colleague Justin Traiteur looked at temperature records from the wind farm in San Gorgonio, Calif., between June 18 and August 9, 1989. The summertime records show that nighttime and early morning temperatures remained higher downwind from the wind farm while...
the rest of the day was cooler. Plugging such weather data into a regional climate model revealed that the impacts were likely due to the increased mixing of the near-surface and higher-atmosphere air thanks to the wind turbines. The researchers suggest this might have impacts on the agricultural fields over which wind turbines typically tower—for instance, protecting crops from frost. "Orange farmers in Florida use giant fans to protect their crops from frost," Roy notes. "Just like wind turbines, these fans generate turbulence and mixing, producing a warming near the surface at night."

On the other hand, wind turbines also have a habit of icing up and, occasionally, throwing ice under those kinds of frost conditions, says Kathryn McCullough, whose family owns a wind farm and an agricultural farm on the same land in Oregon. "We haven't noticed temperature changes from the towers," she says.

More modern wind farms like the McCulloughs' are quite different from the one studied near Palm Springs. The San Gorgonio wind farm had wind turbines just 23 meters tall with 8.5-meter-long blades and towers spaced roughly 120 meters apart; a modern wind farm employs wind turbines some 90 meters tall with blades as long as 40 meters. "Today's turbines are typically spaced at least five times wider apart," explains Bruce Bailey, president of AWS Truepower of Albany, N.Y., a meteorological and engineering consultant to the wind and solar industries. "It's a different technology in terms of how it's deployed today."

In fact, wind developers already take the temperature effect into account because of the impact of "upstream" turbines buffeting the wind on "downstream" turbines. "This near-surface temperature effect is not something new to us," says Michael Holm, a spokesman for wind-turbine manufacturer Vestas. "Vestas works closely together with our customers to prevent this by identifying the best sites for installing wind turbines as we map multiple weather data, including temperatures."

While meteorological readings are more numerous before a project is built—to ensure that a developer is building each turbine in the right place—one or two meteorological towers are usually left in place to continue measuring wind speeds, temperature and other information, according to Bailey, who has conducted hundreds of such meteorological field campaigns for wind-farm developers. "A lot of projects measure temperature," he notes, though those aren't necessarily ground-level measurements like the ones detailed in this paper. "It's a standard measurement because they need to know the air density to determine the power output of the turbine."

Yet Roy and Traiteur were not able to get any such data, according to Roy. "Wind-farm owner/operators may already have such data, but that is not available in the public domain," he says.

Based on the findings, the researchers suggest either designing wind-turbine rotors to minimize turbulence or siting wind farms where natural atmospheric turbulence is high, such as the U.S. Midwest or large parts of northern Europe and China, to cut down on any surface-temperature impacts, if necessary. Of course, wind farms typically sprout up in exactly such turbulent spots, as that's where the wind is strongest—and it's by capturing the energy in the wind that they create more turbulence in the first place, exactly what wind turbines are designed to do, says Mark Ahlstrom, CEO of WindLogics, a wind analysis and forecasting company.

As for the possibility of larger effects as more and more wind farms are built, Roy, at least, remains skeptical. "In a subsequent study that has been submitted to another journal, we found
that these impacts are restricted to a small area around the wind farms,” he says, though some modeling studies of wind turbines covering hundreds of thousands of square kilometers suggest such massive wind farms could affect global climate. "I think that these wind farms, especially if they are spaced sufficiently apart, will not have global-scale effects."

Except one: generating electricity by harvesting the wind rather than burning coal or natural gas cuts down on emissions of carbon dioxide—the primary greenhouse gas changing the global climate. Or, as Roy says, "Wind energy is likely to be a part of the solution of the global warming problem.”
feasible, for if so they can greatly cut down their cost since the resource change from coal to much more cheaper water.

4. **Hydrogeology1**  
06:11 AM 10/5/10  
There are so many "mights" in this article, I might have well skipped it.

5. **Hydrogeology1**  
06:13 AM 10/5/10  
"Highlight," you're a laugh riot!

6. **JamesDavis**  
07:28 AM 10/5/10  
Okay, so they haven't found any problems with wind turbines if they are spaced properly apart. So why don't they check out "Highlite's" idea. If it will work on a sub, and we all know that it does, why wouldn't it work anywhere else? GM has the perfect hydrogen fuel vehicle, originally called 'The Skateboard Car' by its creator; GM can implement that system into that hydrogen vehicle.

7. **jquasimodo**  
08:34 AM 10/5/10  
Interesting that changing the micro-climate is seen as good, while changing macro-climate = bad. Is it true? Around here the first frost is the end of chiggers and ticks until Spring, but if premature can damage crops. Needs more thought but I don't think it's a barrier to using wind power where useful.

The bigger issue is how to store or balance an intermittent power source with continuing loads. The people infatuated with hydrogen have no idea of how expensive it is to use it as a storage and transport medium. (The post about how submarines work is incorrect.)

8. **jbairddo**  
10:45 AM 10/5/10  
Seriously, you want to change mechanical energy (wind) into electrical energy to make potential chemical energy (hydrogen) and then use that to produce heat to produce mechanical energy to run a turbine to produce energy? And somehow this process is so efficient you end up with more energy than you start with. You do know that subs have these huge sources of energy called nuclear reactors, right? Why not just use the turbine energy from the windmill? Seriously, you cannot create more energy than you start with. You do realize that wind energy is basically solar energy converted to mechanical energy?

9. **ennui**  
02:37 PM 10/5/10  
The effect of a few windmills is nothing compared to that of a high building.

When I arrived in Toronto in 1953, July, it was very hot, between 90 and 95 degrees and very humid.

Every night around 6 PM a rainstorm would drench the city for about twenty minutes.

The temperature would go down by about 10 degrees and the
humidity would disappear.
By 7.30 the temperature would creep up and so did the humidity.
Then they started building high rises.
The Rain moved to North of Toronto, for about ten minutes. The Humidity stayed.
More High Rises came into Toronto. The rain north of Toronto disappeared too.
So people complaining about a few windmills should first dismantle a few sky scrapers.

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