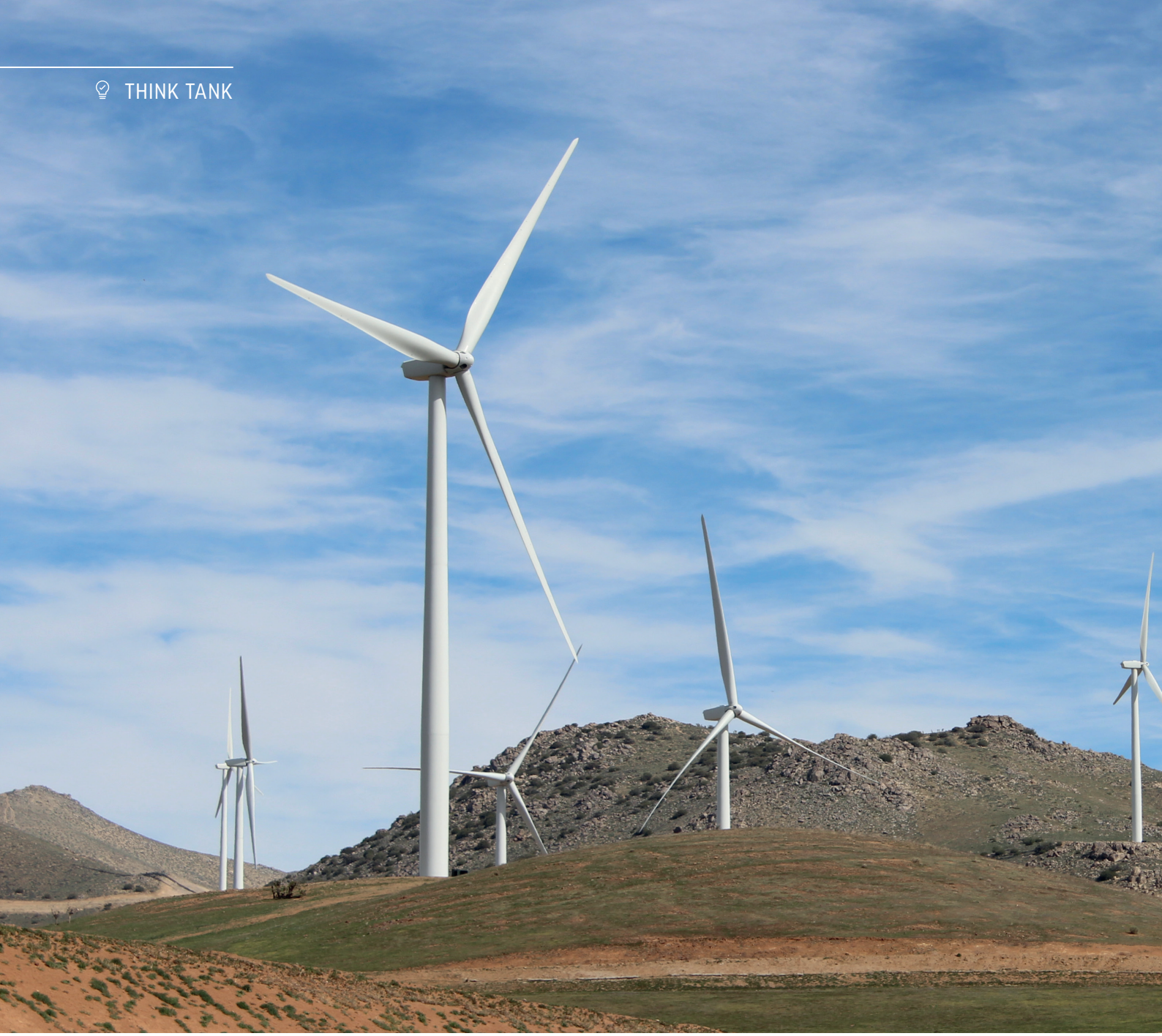
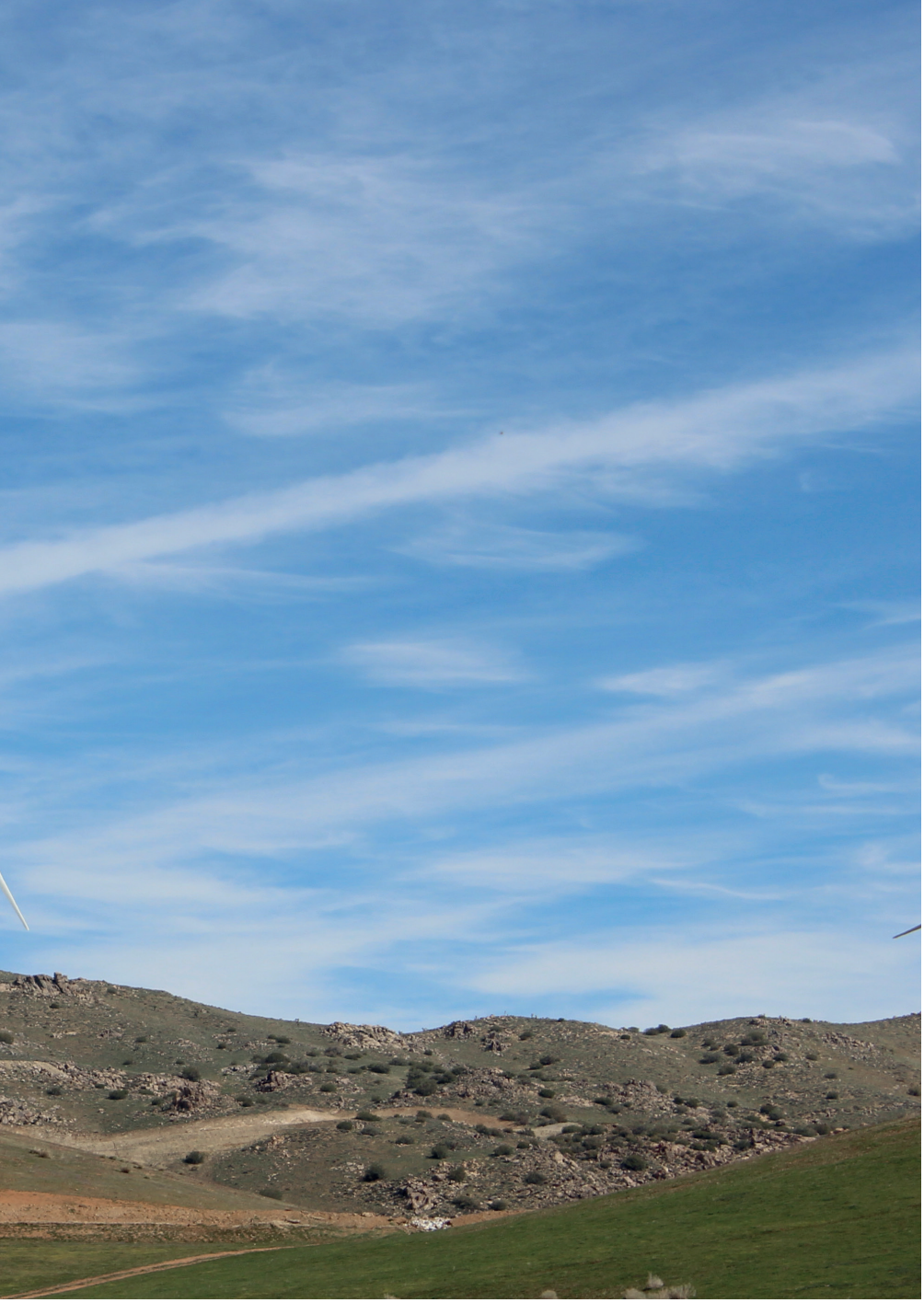


High-performance visibility measurement

Words: Libbie Anderson

Wind energy is one of the forefront sources society has come to depend on as a clean energy solution. Of course, there are always challenges when it comes to implementing new solutions. Wind turbines are a key component of wind energy generation but are known to have some drawbacks that make them less desirable to the public.



A common downside of wind turbines is the light pollution they cause as a result of their aircraft warning lights. The light could be a source of annoyance to homes and workplaces and has been a barrier for the deployment of wind farms near populated areas. Despite their intrusion during good visibility conditions, the warning lights are necessary for safety and navigation during turbulent weather.

These contradicting elements made it necessary to develop a system that could identify when turbine lights needed to be used in full force and when they could be lowered to benefit both aircrafts and residents. To do so, Campbell Scientific developed an affordable visibility sensor that allows visibility measurements to dim lights in good weather conditions.

Campbell Scientific's solution is the CS120A, a high-performance visibility measurement sensor. The CS120A sensor has infrared forward-scatter technology and uses the proven 42-degree scatter angle to report the meteorological observable range for fog and snow in the range of 5 to 75,000 meters.

Compared to similar sensors, the CS120A design measures visibility in a relatively clean space because the position of the heads and body minimize the disturbance of airflow at the measurement volume.

The geometry and downwards-pointing sensor hoods help the CS120A avoid the common problems associated with sunlight shining directly into the lens, which caused errors for other manufacturers' sensors. The sensor is also vibration tested and can withstand the large and varying amounts of vibration on wind turbines.

The CS120A uses continuous high-speed sampling, which improves the accuracy of the measurements taken during adverse weather conditions, like snow or hail, while providing reliable readings during more stable events such as fog and mist. High-speed sampling also allows the sensor to respond to suddenly changing conditions.

After implementing the CS120A, field trials have shown the sensor's hardware and software allow it to work efficiently while working close to aircraft warning light sources.

For aviation applications, the CS120A complies with DWD, UK CAA, FAA, and ICAO guidance and meets or exceeds all recommendations and specifications.

With these intuitive features, the CS120A can make reliable measurements to assess weather conditions. These measurements enable energy providers to adjust warning lights depending on the situation by ensuring accuracy to keep low-flying aviation craft as well as residents in the vicinity safe.

The societal impact of visibility sensors is significant.

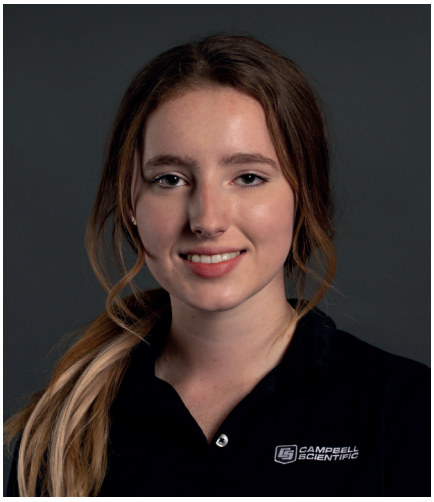
'The main benefit to society is the ability to generate wind power with as little impact on the nearby population while maintaining safety,' said Richard McKay, Senior Project Manager at Campbell Scientific.

According to McKay, not using the visibility sensors on turbines would result in far less renewable energy being generated onshore. This means most, if not all, of the renewable energy would be pushed offshore, causing it to be more expensive and geographically further from the places where much of the energy is needed.

'Using the visibility sensor allows the density of wind turbines to be higher, spatially, onshore and closer to populated areas,' continued McKay.

These onshore sites are possible because the visibility sensor enables turbines to cause light pollution less often.

'In addition to the lights flashing in sync, they are also at the lowest light-intensity levels possible based on visibility. These intensity modifications help reduce the amount of light being produced but maintain the safety



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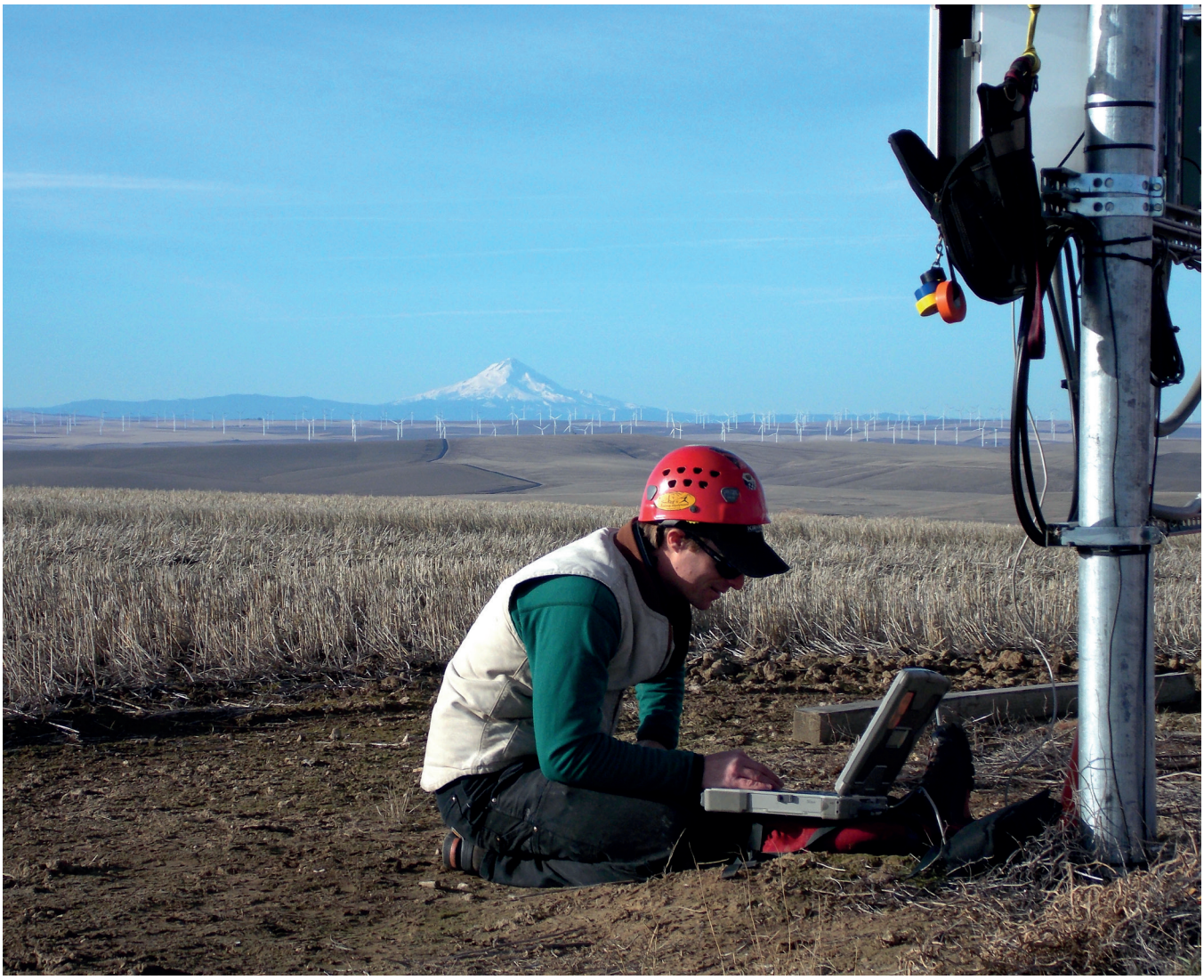

necessary for aviation, especially near densely urbanized areas,' explained McKay.

In addition, the sensors can help to detect danger for those on site when adverse weather conditions, such as freezing precipitation, are present.

'Once detected, the sensor then tells the turbine to shut down so there is no risk of potentially huge sliding ice sheets falling off the blades and hurting people or damaging resources on site,' said McKay.

In recent years, Germany has implemented legislation to allow for the intensity of the lights to adjust accordingly to the visibility conditions. This legislation states that warning lights must burn at a fraction of their original intensity depending on visibility.

'If the conditions are poor, the lights are on full power,' said McKay. 'When conditions are moderate with visibility above 5k, they are only on at around 30% of their maximum intensity. If the conditions are good with visibility above 10k they can be reduced even further to around 10% of maximum.'

The intention of the law is to help avoid the unnecessary use of warning lights. This minimizes the light pollution experienced by the public and enables wind turbines to be less of a disturbance. To fulfill the requirements of the law, turbine operators need to have a system that can notify them of weather conditions and assess when the lights need to be adjusted.

'Germany is currently the only country with these legal regulations. However, some Scandinavian countries are using the same systems as a nice safety feature and particularly value the icing monitoring feature. Canada has also started to use the same systems to monitor for aviation safety and icing in Quebec, but neither are legal obligations in Scandinavia or Canada,' stated McKay.

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