

## Three Sixty Solar Demonstration Tower – 16 Months in Nature

**February 2023**

In October 2021 Three Sixty Solar installed their first demonstration Solar Tower in Kelowna, BC, Canada. Now, 16 months later, Three Sixty has learned a considerable amount about the structure itself, the strength to withstand several extreme weather events, and the power generation impact of soiling compared to reporting on traditional ground mounted and tilted solar panels. All of these learnings are encouraging for the successful utilization of Three Sixty's Solar Towers as they are rolled out commercially.

### The Installation

The foundation work for the demonstration tower was completed on September 28, 2021. Erection of the tower took place over five working days from September 29 through October 8 utilizing a simple bucket lift on site for handling the pieces to stick-build the tower and mount all of the racking and panels.



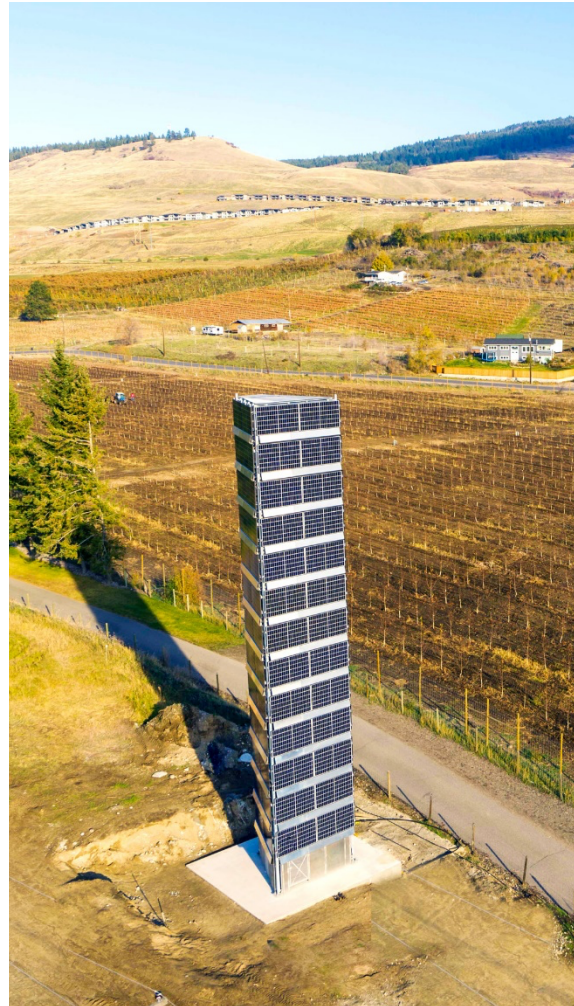
September 29, 2021



October 1, 2021



October 8, 2021



November 2, 2021

### Weather Events

In the second month that the Demonstration Tower was in place, the city of Kelowna experienced a major wind storm. On November 15 and 16, 2021, a severe storm hit, bringing wind gusts in excess of 120 km/hr (75 mph) along with intense rain and hail. According to Global News<sup>1</sup>, the storm left thousands of residents without power and closed schools.

Inspection of the Demonstration Solar Tower on November 17 indicated no damage at all from the storm. All the panels remained firmly intact and attached to the tower and the structure itself remained in as-built condition.

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<sup>1</sup> <https://globalnews.ca/news/8377163/okanagan-hard-hit-by-wind-storm-homes-and-schools-remain-dark-due-to-power-outage/>



According to Environment Canada<sup>2</sup>, in 2022 the strongest wind gusts in Kelowna, BC occurred on November 1, 2022, peaking at 135 km/hr (84 mph). Again, no structural or panel damage were incurred during this storm or any others since the Demonstration Tower was installed.

In mid-December 2021, Kelowna received their first snow of the winter season. Following the arrival of snow, the Demonstration Tower was inspected on December 16 to verify that no wind-driven snow had stuck to the panels, inhibiting their power production, as typically occurs in flatter, ground-mount solar installations. As predicted, the vertical positioning of the panels allowed all snow to slough off the tower, allowing the panels to operate at their full efficiency.



December 16, 2021

In July and August, 2022, the summer brought soaring temperatures, drought conditions, and forest fires to the Okanagan region of BC. In late July, temperatures reached highs of 39C (102F), exceeding the previous record of 37.2C (99F) from 1934. The combined precipitation in September and October 2021 totalled just 12.3 mm<sup>3</sup> (0.48 in), leading to an extended forest fire season throughout the region.

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<sup>2</sup> [https://kelowna.weatherstats.ca/charts/extreme\\_max\\_wind\\_gust-monthly.html](https://kelowna.weatherstats.ca/charts/extreme_max_wind_gust-monthly.html)

<sup>3</sup> <https://kelowna.weatherstats.ca/charts/precipitation-monthly.html>

## Soiling Comparison

After 15 months in situ, Three Sixty's engineers revisited the site on January 23, 2023 to take voltage and current measurements on panels before and after cleaning.

Multiple industry studies have been performed on the impact of soiling on solar panel power production. A study<sup>4</sup> by Kipp & Zonen in association with the Meteorology Division of OTT HydroMet, both based in Germany, concluded that "Solar module shading from dust and other materials can have very substantial impacts on electrical yield, which often can be found in the field to be as high as a 30 percent loss." While the 30% loss number can be associated with more dusty, desert regions, the Kipp & Zonen study cites another study in California from 2001 with soiling caused by lack of rain on a traditional ground-mount tilted solar farm ranging from 1.5% to 6.2% varying across the location of the solar farm.

Three Sixty Solar hypothesized that a primary factor in soiling and loss of power production is the tilt angle of the panels. This hypothesis was supported by a study titled Effect of Tilt Angle on Soiling of Photovoltaic Modules, published by the Arizona State University Photovoltaic Lab in association with the Indian Institute of Technology in 2014<sup>5</sup>. This ASU study examined tilt angles from 0° to 40° to demonstrate a reduction in soiling loss from 2.02% at 0° to just 0.69% at 40°. Unfortunately, the ASU study stopped at a tilt angle of 40°, not allowing for clear extrapolation to Three Sixty's 90° orientation.

During Three Sixty's site visit in January 2023, the voltage and current were measured on panels before and after cleaning. The panels were cleaned by wetting and wiping down with a soft cloth. Both before and after cleaning, the measured voltage from the panels was 77.5V with a current of 6.1A. Immediately after cleaning, no change was measured to either the voltage or current, indicating that there had been no soiling on the panels after more than one year of being on site.

## Conclusions

Three Sixty Solar has drawn two key conclusions from the study of their Demonstration Tower after 16 months in the environment of Kelowna, British Columbia.

First, the structural design is sound and able to withstand extreme weather conditions. Having withstood two wind storms at Category 1 hurricane level (119-153 km/hr (74-95 mph)) without suffering any damage, the design has demonstrated the reliability of Three Sixty's design.

Second, the performance benefits of the 90° tilt angle have been demonstrated positively with regard to avoiding power losses due to soiling. This design feature enables solar farm developers to minimize what can be very costly Operations and Maintenance costs typically associated with having to perform regular cleanings throughout their installations and across decades of life. This is a substantial cost savings for owners and operators to benefit from.

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<sup>4</sup> [https://info.otthydro.com/1928\\_KZ\\_CNT\\_c-met\\_DustIQ-Soiling-Whitepaper-all\\_EN\\_19-Landing-Page.html](https://info.otthydro.com/1928_KZ_CNT_c-met_DustIQ-Soiling-Whitepaper-all_EN_19-Landing-Page.html)

<sup>5</sup> J Cano, J Joseph John, S Tatpudi, and M Tamizh, "Effect of Tilt Angle on Soiling of Photovoltaic Modules", 2014