

## 2021 Q2

## (PERCENTAGES)

One Energy is conducting an energy production estimate for a potential 3-turbine project. The Gross Annual Energy Production (AEP) has been determined to be 5,153,000 kWh for each turbine. The Gross AEP is the energy produced by the turbine with no losses considered. The next step is to determine the wake loss associated with the project. Wake loss causes a decrease in energy production due to the turbine's interactions with each other – when one turbine is located downwind (behind) another turbine, it experiences lower wind speeds (wake loss) and thus less energy production. Applying the wake loss to the Gross AEP will result in the Net AEP.

**Level 1:** One Energy's wake loss model is run for the turbine siting. The wake loss percentage for each turbine is as shown below:

TURBINE	WAKE LOSS
T1	1.2%
T2	3.7%
T3	2.9%

What is the total Net AEP for the project? Round to the nearest kWh.

**Level 2:** One Energy later ran the wake loss model for the project on a monthly basis – a different wake loss number was determined for each month for each turbine. The monthly variation in wake loss is due to variation in wind direction throughout the year. The project's monthly ratios (the percentage of energy production that occurs in each month) were also calculated. Like wind direction, wind speed (and thus energy production) varies throughout the year. The monthly ratios and the monthly wake loss are shown below:

MONTH	MONTHLY RATIO	T1 WAKE LOSS	T2 WAKE LOSS	T3 WAKE LOSS
Jan	11.09%	1.18%	3.62%	1.57%
Feb	9.39%	1.35%	4.25%	1.98%
Mar	10.31%	1.64%	4.96%	4.59%
Apr	10.34%	0.80%	2.65%	4.37%
May	8.39%	1.21%	3.70%	2.76%
Jun	6.18%	0.53%	1.75%	2.94%
Jul	5.06%	0.41%	1.73%	2.96%
Aug	4.42%	0.59%	1.86%	3.30%
Sep	6.02%	1.92%	5.80%	3.88%
Oct	9.03%	1.86%	5.67%	2.20%
Nov	9.83%	1.08%	3.21%	3.02%
Dec	9.94%	1.17%	3.53%	1.76%

What is the gross energy production for one turbine for April? What is the site total net energy production for April? Round to the nearest kWh.

# WIND STUDY

Wind Study is intended for grades 5-8 and 8-11

Questions posted on: Monday    Answers posted on: Friday

Find downloadable one-pagers at [www.oneenergy.com/one-energy-feed](http://www.oneenergy.com/one-energy-feed)

*A completed wind turbine project. With the current wind direction, the turbines on the right side of the picture will experience lower wind speeds, caused by wake loss due to the other turbines.*

