

The Effect of Particulate Matter on Solar Energy

Seth Welly, Cameron Sherette
Toledo Technology Academy of Engineering

Introduction

How does particulate matter affect solar panel efficiency? The purpose of this research project is to find the relationship between air quality and solar panel outputs. One of the best sources showed that there is an effect of particulate matter deposition on solar panel efficiency (Kim, 2024). Air pollutants have become a serious environmental problem in recent years. Not only does it affect living creatures, but it also impacts the energy output of solar panels. Due to a rise in the amount of air pollutants, due to increased carbon emissions. The particulate matter in the air is acting as a barrier, blocking sunlight from reaching the panels. This issue can cause a lot of energy to be wasted because of the increase in carbon emissions (Chandler, 2019).

Hypothesis

Air quality, specifically particulate matter, will have a negative effect on the output of solar panel arrays. This will occur because the particulate matter will deposit onto the panels and block light from reaching the lower levels of the panel (Roumpakias, Stamatielos, 2020).

Objective

To find the relationship between particulate matter and the output of solar panels in kWh.

Methods

- Bring the iPad and engineers notebooks to record data.
- Go onto the roof for a good connection with the sensors and to check on the sensors and solar panel array, done at 9-10 AM.
- Use the Davis app and Purple Air website to get PM1, PM2.5, PM5, and PM10.
- Use the APsystems website to get kWh data from the solar panel array output.
- Ensure the data is accurate and correct.
- Use a graphing website such as StatsBlue and graphs on Google Sheets to create a graph and analyze the data that was collected.

Utilizing the Ipad and Davis weather app



There does not seem to be a significant correlation between particulate matter and solar output. Effect on solar panel output is hard to notice when looking at a graph or raw data numbers for analysis.

Raw Data

Time	PM10	PM2.5	PM5	PM1	PM0.1	PM0.3	PM0.5	PM0.7	PM0.9	PM1.1	PM1.3	PM1.5	PM1.7	PM1.9	PM2.1	PM2.3	PM2.5	PM2.7	PM2.9	PM3.1	PM3.3	PM3.5	PM3.7	PM3.9	PM4.1	PM4.3	PM4.5	PM4.7	PM4.9	PM5.1	PM5.3	PM5.5	PM5.7	PM5.9	PM6.1	PM6.3	PM6.5	PM6.7	PM6.9	PM7.1	PM7.3	PM7.5	PM7.7	PM7.9	PM8.1	PM8.3	PM8.5	PM8.7	PM8.9	PM9.1	PM9.3	PM9.5	PM9.7	PM9.9	PM10.1	PM10.3	PM10.5	PM10.7	PM10.9	PM11.1	PM11.3	PM11.5	PM11.7	PM11.9	PM12.1	PM12.3	PM12.5	PM12.7	PM12.9	PM13.1	PM13.3	PM13.5	PM13.7	PM13.9	PM14.1	PM14.3	PM14.5	PM14.7	PM14.9	PM15.1	PM15.3	PM15.5	PM15.7	PM15.9	PM16.1	PM16.3	PM16.5	PM16.7	PM16.9	PM17.1	PM17.3	PM17.5	PM17.7	PM17.9	PM18.1	PM18.3	PM18.5	PM18.7	PM18.9	PM19.1	PM19.3	PM19.5	PM19.7	PM19.9	PM20.1	PM20.3	PM20.5	PM20.7	PM20.9	PM21.1	PM21.3	PM21.5	PM21.7	PM21.9	PM22.1	PM22.3	PM22.5	PM22.7	PM22.9	PM23.1	PM23.3	PM23.5	PM23.7	PM23.9	PM24.1	PM24.3	PM24.5	PM24.7	PM24.9	PM25.1	PM25.3	PM25.5	PM25.7	PM25.9	PM26.1	PM26.3	PM26.5	PM26.7	PM26.9	PM27.1	PM27.3	PM27.5	PM27.7	PM27.9	PM28.1	PM28.3	PM28.5	PM28.7	PM28.9	PM29.1	PM29.3	PM29.5	PM29.7	PM29.9	PM30.1	PM30.3	PM30.5	PM30.7	PM30.9	PM31.1	PM31.3	PM31.5	PM31.7	PM31.9	PM32.1	PM32.3	PM32.5	PM32.7	PM32.9	PM33.1	PM33.3	PM33.5	PM33.7	PM33.9	PM34.1	PM34.3	PM34.5	PM34.7	PM34.9	PM35.1	PM35.3	PM35.5	PM35.7	PM35.9	PM36.1	PM36.3	PM36.5	PM36.7	PM36.9	PM37.1	PM37.3	PM37.5	PM37.7	PM37.9	PM38.1	PM38.3	PM38.5	PM38.7	PM38.9	PM39.1	PM39.3	PM39.5	PM39.7	PM39.9	PM40.1	PM40.3	PM40.5	PM40.7	PM40.9	PM41.1	PM41.3	PM41.5	PM41.7	PM41.9	PM42.1	PM42.3	PM42.5	PM42.7	PM42.9	PM43.1	PM43.3	PM43.5	PM43.7	PM43.9	PM44.1	PM44.3	PM44.5	PM44.7	PM44.9	PM45.1	PM45.3	PM45.5	PM45.7	PM45.9	PM46.1	PM46.3	PM46.5	PM46.7	PM46.9	PM47.1	PM47.3	PM47.5	PM47.7	PM47.9	PM48.1	PM48.3	PM48.5	PM48.7	PM48.9	PM49.1	PM49.3	PM49.5	PM49.7	PM49.9	PM50.1	PM50.3	PM50.5	PM50.7	PM50.9	PM51.1	PM51.3	PM51.5	PM51.7	PM51.9	PM52.1	PM52.3	PM52.5	PM52.7	PM52.9	PM53.1	PM53.3	PM53.5	PM53.7	PM53.9	PM54.1	PM54.3	PM54.5	PM54.7	PM54.9	PM55.1	PM55.3	PM55.5	PM55.7	PM55.9	PM56.1	PM56.3	PM56.5	PM56.7	PM56.9	PM57.1	PM57.3	PM57.5	PM57.7	PM57.9	PM58.1	PM58.3	PM58.5	PM58.7	PM58.9	PM59.1	PM59.3	PM59.5	PM59.7	PM59.9	PM60.1	PM60.3	PM60.5	PM60.7	PM60.9	PM61.1	PM61.3	PM61.5	PM61.7	PM61.9	PM62.1	PM62.3	PM62.5	PM62.7	PM62.9	PM63.1	PM63.3	PM63.5	PM63.7	PM63.9	PM64.1	PM64.3	PM64.5	PM64.7	PM64.9	PM65.1	PM65.3	PM65.5	PM65.7	PM65.9	PM66.1	PM66.3	PM66.5	PM66.7	PM66.9	PM67.1	PM67.3	PM67.5	PM67.7	PM67.9	PM68.1	PM68.3	PM68.5	PM68.7	PM68.9	PM69.1	PM69.3	PM69.5	PM69.7	PM69.9	PM70.1	PM70.3	PM70.5	PM70.7	PM70.9	PM71.1	PM71.3	PM71.5	PM71.7	PM71.9	PM72.1	PM72.3	PM72.5	PM72.7	PM72.9	PM73.1	PM73.3	PM73.5	PM73.7	PM73.9	PM74.1	PM74.3	PM74.5	PM74.7	PM74.9	PM75.1	PM75.3	PM75.5	PM75.7	PM75.9	PM76.1	PM76.3	PM76.5	PM76.7	PM76.9	PM77.1	PM77.3	PM77.5	PM77.7	PM77.9	PM78.1	PM78.3	PM78.5	PM78.7	PM78.9	PM79.1	PM79.3	PM79.5	PM79.7	PM79.9	PM80.1	PM80.3	PM80.5	PM80.7	PM80.9	PM81.1	PM81.3	PM81.5	PM81.7	PM81.9	PM82.1	PM82.3	PM82.5	PM82.7	PM82.9	PM83.1	PM83.3	PM83.5	PM83.7	PM83.9	PM84.1	PM84.3	PM84.5	PM84.7	PM84.9	PM85.1	PM85.3	PM85.5	PM85.7	PM85.9	PM86.1	PM86.3	PM86.5	PM86.7	PM86.9	PM87.1	PM87.3	PM87.5	PM87.7	PM87.9	PM88.1	PM88.3	PM88.5	PM88.7	PM88.9	PM89.1	PM89.3	PM89.5	PM89.7	PM89.9	PM90.1	PM90.3	PM90.5	PM90.7	PM90.9	PM91.1	PM91.3	PM91.5	PM91.7	PM91.9	PM92.1	PM92.3	PM92.5	PM92.7	PM92.9	PM93.1	PM93.3	PM93.5	PM93.7	PM93.9	PM94.1	PM94.3	PM94.5	PM94.7	PM94.9	PM95.1	PM95.3	PM95.5	PM95.7	PM95.9	PM96.1	PM96.3	PM96.5	PM96.7	PM96.9	PM97.1	PM97.3	PM97.5	PM97.7	PM97.9	PM98.1	PM98.3	PM98.5	PM98.7	PM98.9	PM99.1	PM99.3	PM99.5	PM99.7	PM99.9	PM100.1	PM100.3	PM100.5	PM100.7	PM100.9	PM101.1	PM101.3	PM101.5	PM101.7	PM101.9	PM102.1	PM102.3	PM102.5	PM102.7	PM102.9	PM103.1	PM103.3	PM103.5	PM103.7	PM103.9	PM104.1	PM104.3	PM104.5	PM104.7	PM104.9	PM105.1	PM105.3	PM105.5	PM105.7	PM105.9	PM106.1	PM106.3	PM106.5	PM106.7	PM106.9	PM107.1	PM107.3	PM107.5	PM107.7	PM107.9	PM108.1	PM108.3	PM108.5	PM108.7	PM108.9	PM109.1	PM109.3	PM109.5	PM109.7	PM109.9	PM110.1	PM110.3	PM110.5	PM110.7	PM110.9	PM111.1	PM111.3	PM111.5	PM111.7	PM111.9	PM112.1	PM112.3	PM112.5	PM112.7	PM112.9	PM113.1	PM113.3	PM113.5	PM113.7	PM113.9	PM114.1	PM114.3	PM114.5	PM114.7	PM114.9	PM115.1	PM115.3	PM115.5	PM115.7	PM115.9	PM116.1	PM116.3	PM116.5	PM116.7	PM116.9	PM117.1	PM117.3	PM117.5	PM117.7	PM117.9	PM118.1	PM118.3	PM118.5	PM118.7	PM118.9	PM119.1	PM119.3	PM119.5	PM119.7	PM119.9	PM120.1	PM120.3	PM120.5	PM120.7	PM120.9	PM121.1	PM121.3	PM121.5	PM121.7	PM121.9	PM122.1	PM122.3	PM122.5	PM122.7	PM122.9	PM123.1	PM123.3	PM123.5	PM123.7	PM123.9	PM124.1	PM124.3	PM124.5	PM124.7	PM124.9	PM125.1	PM125.3	PM125.5	PM125.7	PM125.9	PM126.1	PM126.3	PM126.5	PM126.7	PM126.9	PM127.1	PM127.3	PM127.5	PM127.7	PM127.9	PM128.1	PM128.3	PM128.5	PM128.7	PM128.9	PM129.1	PM129.3	PM129.5	PM129.7	PM129.9	PM130.1	PM130.3	PM130.5	PM130.7	PM130.9	PM131.1	PM131.3	PM131.5	PM131.7	PM131.9	PM132.1	PM132.3	PM132.5	PM132.7	PM132.9	PM133.1	PM133.3	PM133.5	PM133.7	PM133.9	PM134.1	PM134.3	PM134.5	PM134.7	PM134.9	PM135.1	PM135.3	PM135.5	PM135.7	PM135.9	PM136.1	PM136.3	PM136.5	PM136.7	PM136.9	PM137.1	PM137.3	PM137.5	PM137.7	PM137.9	PM138.1	PM138.3	PM138.5	PM138.7	PM138.9	PM139.1	PM139.3	PM139.5	PM139.7	PM139.9	PM140.1	PM140.3	PM140.5	PM140.7	PM140.9	PM141.1	PM141.3	PM141.5	PM141.7	PM141.9	PM142.1	PM142.3	PM142.5	PM142.7	PM142.9	PM143.1	PM143.3	PM143.5	PM143.7	PM143.9	PM144.1	PM144.3	PM144.5	PM144.7	PM144.9	PM145.1	PM145.3	PM145.5	PM145.7	PM145.9	PM146.1	PM146.3	PM146.5	PM146.7	PM146.9	PM147.1	PM147.3	PM147.5	PM147.7	PM147.9	PM148.1	PM148.3	PM148.5	PM148.7	PM148.9	PM149.1	PM149.3	PM149.5	PM149.7	PM149.9	PM150.1	PM150.3	PM150.5	PM150.7	PM150.9	PM151.1	PM151.3	PM151.5	PM151.7	PM151.9	PM152.1	PM152.3	PM152.5	PM152.7	PM152.9	PM153.1	PM153.3	PM153.5	PM153.7	PM153.9	PM154.1	PM154.3	PM154.5	PM154.7	PM154.9	PM155.1	PM155.3	PM155.5	PM155.7	PM155.9	PM156.1	PM156.3	PM156.5	PM156.7	PM156.9	PM157.1	PM157.3	PM157.5	PM157.7	PM157.9	PM158.1	PM158.3	PM158.5	PM158.7	PM158.9	PM159.1	PM159.3	PM159.5	PM159.7	PM159.9	PM160.1	PM160.3	PM160.5	PM160.7	PM160.9	PM161.1	PM161.3	PM161.5	PM161.7	PM161.9	PM162.1	PM162.3	PM162.5	PM162.7	PM162.9	PM163.1	PM163.3	PM163.5	PM163.7	PM163.9	PM164.1	PM164.3	PM164.5	PM164.7	PM164.9	PM165.1	PM165.3	PM165.5	PM165.7	PM165.9	PM166.1	PM166.3	PM166.5	PM166.7	PM166.9	PM167.1	PM167.3	PM167.5	PM167.7	PM167.9	PM168.1	PM168.3	PM168.5	PM168.7	PM168.9	PM169.1	PM169.3	PM169.5	PM169.7	PM169.9	PM170.1	PM170.3	PM170.5	PM170.7	PM170.9	PM171.1	PM171.3	PM171.5	PM171.7	PM171.9	PM172.1	PM172.3	PM172.5	PM172.7	PM172.9	PM173.1	PM173.3	PM173.5	PM173.7	PM173.9	PM174.1	PM174.3	PM174.5	PM174.7	PM174.9	PM175.1	PM175.3	PM175.5	PM175.7	PM175.9	PM176.1	PM176.3	PM176.5	PM176.7	PM176.9	PM177.1	PM177.3	PM177.5	PM177.7	PM177.9	PM178.1	PM178.3	PM178.5	PM178.7	PM178.9	PM179.1	PM179.3	PM179.5	PM179.7	PM179.9	PM180.1	PM180.3	PM180.5	PM180.7	PM180.9	PM181.1	PM181.3	PM181.5	PM181.7	PM181.9	PM182.1	PM182.3	PM182.5	PM182.7	PM182.9	PM183.1	PM183.3	PM183.5	PM183.7	PM183.9	PM184.1	PM184.3	PM184.5	PM184.7	PM184.9	PM185.1	PM185.3	PM185.5	PM185.7	PM185.9	PM186.1	PM186.3	PM186.5	PM186.7	PM186.9	PM187.1	PM187.3	PM187.5	PM187.7	PM187.9	PM188.1	PM188.3	PM188.5	PM188.7	PM188.9	PM189.1	PM189.3	PM189.5	PM189.7	PM189.9	PM190.1	PM190.3	PM190.5	PM190.7	PM190.9	PM191.1	PM191.3	PM191.5	PM191.7	PM191.9	PM192.1	PM192.3	PM192.5	PM192.7	PM192.9	PM193.1	PM193.3	PM193.5	PM193.7	PM193.9	PM194.1	PM194.3	PM194.5	PM194.7	PM194.9	PM195.1	PM195.3	PM195.5	PM195.7	PM195.9	PM196.1	PM196.3	PM196.5	PM196.7	PM196.9	PM197.1	PM197.3	PM197.5	PM197.7	PM197.9	PM198.1	PM198.3	PM198.5	PM198.7	PM198.9	PM199.1	PM199.3	PM199.5	PM199.7	PM199.9	PM200.1	PM200.3	PM200.5	PM200.7	PM200.9	PM201.1	PM201.3	PM201.5	PM201.7	PM201.9	PM202.1	PM202.3	PM202.5	PM202.7	PM202.9	PM203.1	PM203.3	PM203.5	PM203.7	PM203.9	PM204.1	PM204.3	PM204.5	PM204.7	PM204.9	PM205.1	PM205.3	PM205.5	PM205.7	PM205.9	PM206.1	PM206.3	PM206.5	PM206.7	PM206.9	PM207.1	PM207.3	PM207.5	PM207.7	PM207.9	PM208.1	PM208.3	PM208.5	PM208.7	PM208.9	PM209.1	PM209.3	PM209.5	PM209.7	PM209.9	PM210.1	PM210.3	PM210.5	PM210.7	PM210.9	PM211.1	PM211.3	PM211.5	PM211.7	PM211.9	PM212.1	PM212.3	PM212.5	PM212.7	PM212.9	PM213.1	PM213.3	PM213.5	PM213.7	PM213.9	PM214.1	PM214.3	PM214.5	PM214.7	PM214.9	PM215.1	PM215.3	PM215.5	PM215.7	PM215.9	PM216.1	PM216.3	PM216.5	PM216.7	PM216.9	PM217.1	PM217.3	PM217.5	PM217.7	PM217.9	PM218.1	PM218.3	PM218.5	PM218.7	PM218.9	PM219.1	PM219.3	PM219.5	PM219.7	PM219.9	PM220.1	PM220.3	PM220.5	PM220.7	PM220.9	PM221.1	PM221.3	PM221.5	PM221.7	PM221.9	PM222.1	PM222.3	PM222.5	PM222.7	PM222.9	PM223.1	PM223.3	PM223.5	PM223.7	PM223.9	PM224.1	PM224.3	PM224.5	PM224.7	PM224.9	PM225.1	PM225.3	PM225.5	PM225.7	PM225.9	PM226.1	PM226.3	PM226.5	PM226.7	PM226.9	PM227.1	PM227.3	PM227.5	PM227.7	PM227.9	PM228.1	PM228.3	PM228.5	PM228.7	PM228.9	PM229.1	PM229.3	PM229.5	PM229.7	PM229.9	PM230.1	PM230.3	PM230.5	PM230.7	PM230.9	PM231.1	PM231.3	PM231.5	PM231.7	PM231.9	PM232.1	PM232.3	PM232.5	PM232.7	PM232.9	PM233.1	PM233.3	PM233.5	PM233.7	PM233.9	PM234.1	PM234.3
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