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Understanding Green Technologies

The Power of the Sun or "Watts on Pluto?"

Many effects in nature follow what is known as the "Inverse Square Law". One example is the power from the sun that shines on a given sized area of a planet. As we move away from the sun the power of the sunlight shining on the same sized area decreases proportionally as the square of the distance from the sun.

On earth, we may receive 100 Watts of solar power per square foot of surface area. If the earth was twice as far from the sun we would only receive 25 Watts per square foot. [100 x $(½)^2$ = 100 x ¼ = 25]. Similarly, if the earth was twice as close to the sun we would receive 400 Watts per square foot [100 x $(2)^2$ = 100 x 4 = 400]

This is a photograph of a 2,000 Watt solar power system. Here, on earth, it can generate 2,000 Watts of electricity from the available sunlight. Can you calculate how much electricity this system would generate on another planet – say Pluto?
(Assume all the planets have an atmosphere like the earth's atmosphere – keep it simple!!)

Planetary Data

Planet	Distance from the sun in millions of miles
Mercury	36
Venus	67
Earth	93
Mars	142
Jupiter	483
Saturn	887
Uranus	1,783
Neptune	2,794
Pluto	3,666

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SOLUTION

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Distance from the sun to the earth: 93 million miles

Distance from the sun to the planet Pluto: 3,666 million miles

Power generated by an (earth) 2,000 Watt solar electric system on Pluto:

$= 2{,}000 \times (93/3{,}666)^2 = 2{,}000 \times (0.025)^2$

$= 2{,}000 \times 0.000625 = 1.25$ Watts

If the same solar electric system was placed on the other planets it would generate:

Mercury	13,347 Watts
Venus	3,853 Watts
Earth	2,000 Watts
Mars	858 Watts
Jupiter	74 Watts
Saturn	22 Watts
Uranus	5.44 Watts
Neptune	2.22 Watts
Pluto	1.25 Watts