What Happened to All the Energy?

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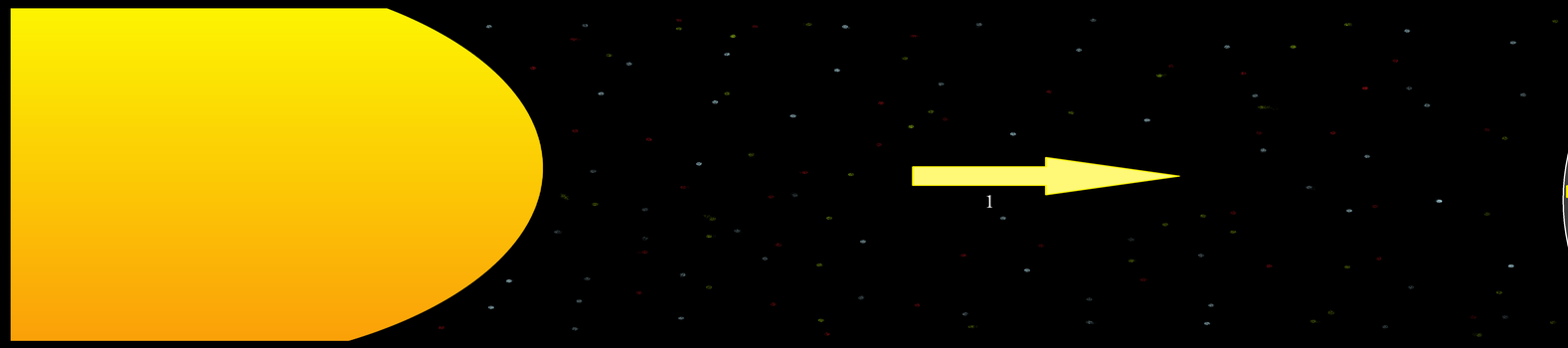
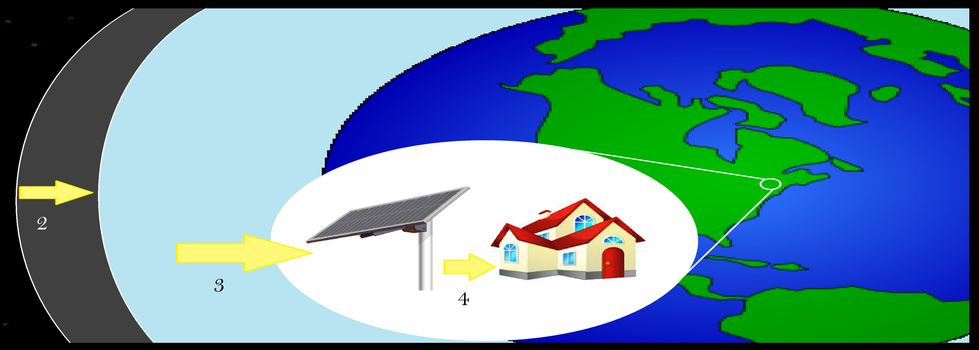
The Energy Battle

Energy or more recently energy sources have been an area of contention. As scientists and activists have concerned themselves using products that are less harmful to the environment new ways of harvesting energy have needed to be implemented. Fossil fuels, while they tend to give the most bang for their buck in terms of energy output, are drying up and their use is harmful to the environment. One of the many proposed solutions to this energy crisis turned scientists to the very source that gives all things on Earth life to begin with, the Sun. Solar Energy seems to be going in popularity in the science sector as the sun itself emits $3.8*10^{26}$ Joules of energy per second.

While the sun appears to be the obvious winner in amount of energy released per second it poses many challenges. The amount of energy given off by the Sun does not reach the Earth's surface and what does is not efficiently passed on to ones home. This poster will explore what happened to the energy, what factors effect the amount of energy the Earth receives and how can optimization of energy to homes be achieved.





Models and Assumptions

Models

- Snell's Law $\{n_1\sin(t_1)=n_2\sin(t_2)\}$ determines the angle that light passes to the next stage
  *In the atmosphere the index of refraction is dependent on the height $\{n=1.02\cot(h+(10.3/(h+5.11)))\}$
- Light is both reflected and transmitted through each transition
- The solar panel is a photovoltaic solar cell which needs 1.12eV to excite the electron-hole pair
- The solar panel has standard glass as first layer
- There are no thermal components within the solar cell so only light with wavelength

Assumptions

- There are only 4 areas of energy loss
  1.The transition from space to the outer atmosphere
  2.The transition from the outer atmosphere to the inner atmosphere
  3.The transition from the inner atmosphere to the solar cell
  4.The components of the solar cell
- The Sun produces $2.8728*10^{33}$J per year in Lansing, MI
  *Lansing receives 175 days of sunlight of which 12 hours of those days are sunny
- The light from the sun hits the atmosphere at 90-degrees

Results

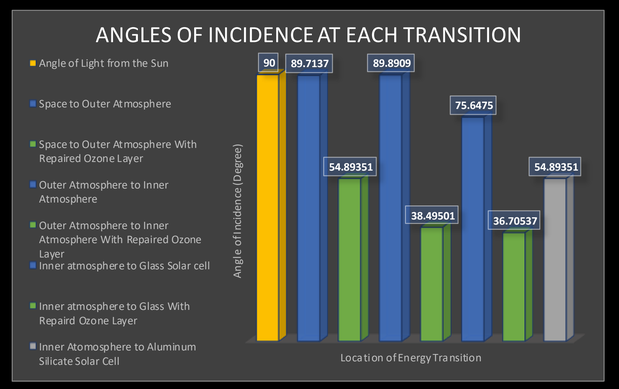


Figure 1. Angles of Incidence at Each Transition– The yellow bar represents the angle that the sun approaches the out atmosphere. The blue bars are the angles of incidence given the current densities of the different layers of the atmosphere. The green bars represent the angles of incidence given that the ozone layer gets repaired to its former thickness before the industrial revolution. The grey bar represents the angle of incidence given an aluminum silicate coating on the solar panel instead of traditional glass.

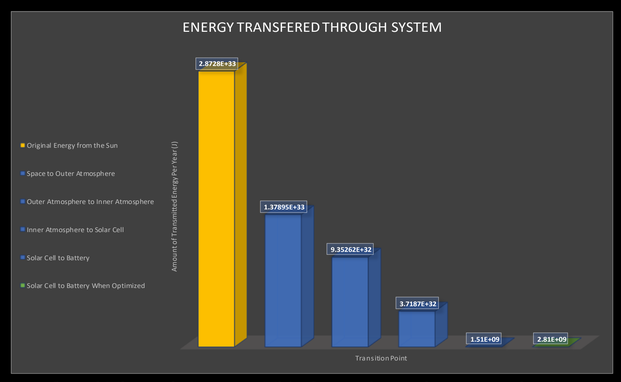


Figure 2. Energy Transferred Through System– This figure shows the energy that is transmitted through the system for an entire year. Any loses in energy for the first three bars are from the rest of the light being reflected. The last bar is dramatically reduced because only one wavelength of light is used (1107.78 nm).

Discussion and Conclusion

Discussion

- The angle of incidence was almost 90-degrees for the layers of the atmosphere given the current conditions of the layers.
- With a repaired ozone layer the angle of incidence changes dramatically because the pressure and air density is increased.
- The angle of incidence is important to the function of a solar panel. The light needs to be perpendicular to the internal materials of a solar panel for optimal levels of energy production.
- Aluminum silicate was chosen as the alternative to glass because of new studies attempting to make photovoltaic paint.
- A current theory is that partnering solar panels with this paint will increase energy production
- The green bar in figure 2 shows the amount of energy that could be obtained by the solar panel if it were optimized.
- Optimization of solar panels can happen in various ways
  *Hybridizing the solar panel with photovoltaic and thermal cells
  *Allowing the solar panel to track the sun
  *Insulating the layers of the solar panels with phase change materials (PCMs)

Conclusion

- The largest amount of energy was lost once it reached the glass layer solar panels
- The solar panels themselves are very inefficient
- As the ozone layer becomes thicker the amount of energy passing through will decrease
- As more efforts are made to patch the ozone layers solar panels will need to be adjusted to compensate for the new angles of incidences