ABSTRACT
Solar energy has seen the emergence of the colloidal quantum-dot solar cell, a novel form of photon collection which offers the possibility of increasing the theoretical efficiency of solar panels while also substantially cutting the costs of production. Quantum dot solar panels, the topic of this paper, are exciting due to their ability to be tuned to a wider spectrum of electromagnetic radiation and their ability to withstand external damages through the use of ligands. Quantum-dots are made of nanoscale particles, most often PbS, that have organic ligands attached all around, creating a molecular shield which protects the cell from outdoor elements. In this paper, the technology, cost, importance, and applications of colloidal quantum-dot solar cells will be discussed. The focus of the research and the most obvious application for colloidal quantum-dot solar cells is a power source for homes and businesses. With increasing uses and applications of any new technology, scientists need to question whether it is significant and ethical. As society continues to push towards sustainability, solar energy is often brought up. Colloidal quantum-dot solar cells serve as an environmentally friendly solution to the power problem. The economical, versatile applications prove that this technology will be significant to the future of energy.

COLLOIDAL QUANTUM-DOT
Passivated (left) versus non-passivated (right) PbS CQD. The passivation allows the solar cell to resist reacting with oxygen, which protects the cell from degrading and lengthens the device’s lifespan.

PASSIVATION
A common agent for passivating a CQD is Ortho-Phthaldehyde. Also known as OPA, this inorganic substance is easily produced in labs and inexpensive compared to other ligands.

LAYOUT
Typical layouts for CQDs are in p-i-n semiconductor matrices, oftentimes in 3-dimension (seen on the right), or submerging the CQD in a solution of a blend of polymers (seen on the left).

RESULTS
On the left depicts PbS CQDs exposed to oxygen without passivation, whereas on the right shows CQDs passivated by OPA. Notice the degradation of the cells without passivation compared to the state of those passivated on the right. With less oxygen affecting the collection of photons, the passivated solar cells can function more efficiently.

<table>
<thead>
<tr>
<th>Ligand</th>
<th>V_{oc}</th>
<th>I_{sc}</th>
<th>PCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0.4</td>
<td>38.5%</td>
<td>1.71%</td>
</tr>
<tr>
<td>TDPA</td>
<td>0.48</td>
<td>43.1%</td>
<td>2.86%</td>
</tr>
<tr>
<td>OPA</td>
<td>0.46</td>
<td>47%</td>
<td>5.04%</td>
</tr>
</tbody>
</table>

Although the OPA-passivated cell has a lower open-circuit voltage than the TDPA cell, the Power Conversion Efficiency and Electron-Hole mobility of the OPA-passivated solar cell, which measure the overall efficiency of the solar cell and the ability of electron-hole pairs to induce an extra pair when capturing an electron, surpass those of the non-passivated and TDPA-passivated cell, giving concrete statistics that OPA passivation is beneficial to the CQD.

ENVIRONMENTAL IMPACT
The graph above displays the temperature anomalies from 1885 to 2015 in the eastern tropical Pacific. The anomaly is the deviation of the mean temperature from the normal average temperature indexed from the year 1885. A clear increase in average temperature is not only established, but rising as each year passes.

The graph on the left depicts the cumulative production, Q, versus the rate of production of the whole world, P. The linear dependence between the two shows that as Shell’s own production increases, the worldwide production decreases. This shows the magnitude at which fossil fuels are being collected for energy. In the right is the normal distribution of drilling patterns for oil compared to time. This figure shows that at time $t_{max}$, the crude oil supply is half depleted. Actions must be taken to reduce dependence upon crude oil for energy, and CQDs can play a huge factor in shifting this dependence.