

# Increasing Efficiency in Solar Energy Systems: Graphene-Based Panels and Batteries

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# Introduction

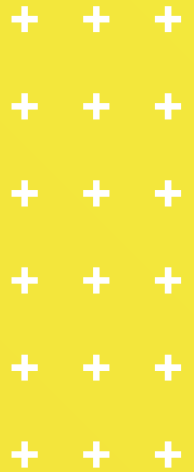


**The use of renewable energy is essential.**

**It is important to create more efficient systems for producing and storing energy to meet energy demand.**



# Map of the Presentation



**Working Principles of  
Lithium Batteries**

**01**

**02**

**Improvements in  
Lithium-Ion Batteries  
with Graphene**

**Working Principle of  
Solar Panels**

**03**

**04**

**Improvements to Solar  
Panels with Graphene**

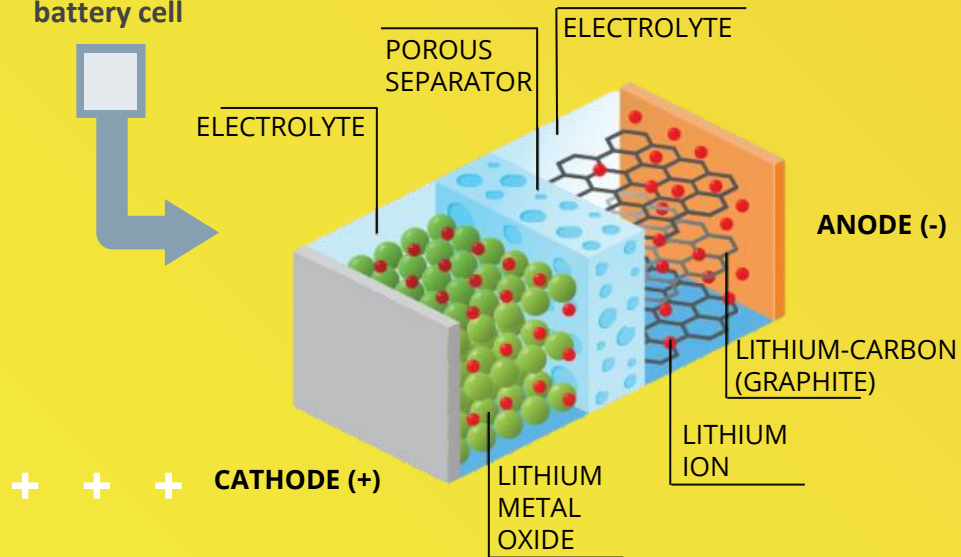




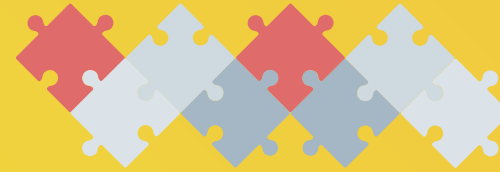
# 01

## Working Principles of Lithium Batteries

Model of a lithium battery cell

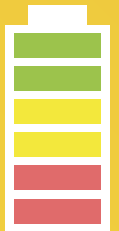


A battery is made up of many of these cells joined together



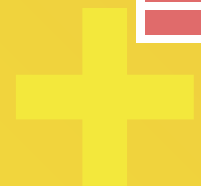
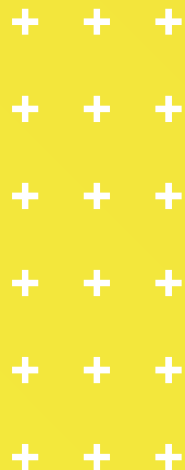
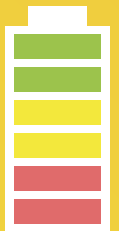
Discharge Cycle

Electrons will pass through the load and the lithium ions will pass through the electrolyte.



Charge Cycle

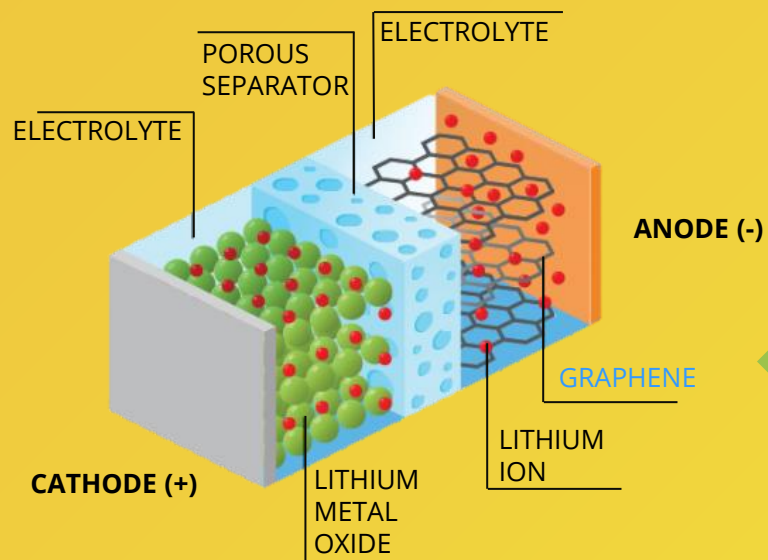
Electrons will pass through the load and return to graphite. The lithium ions will pass through the electrolyte and back with the graphite and electrons.





# 02

## Improvements in Lithium-Ion Batteries with Graphene



Replace



Thermal and chemical stability

Solve the dilation problems during battery charging and discharging

Security

Reduce the size and weight of batteries to save space in devices



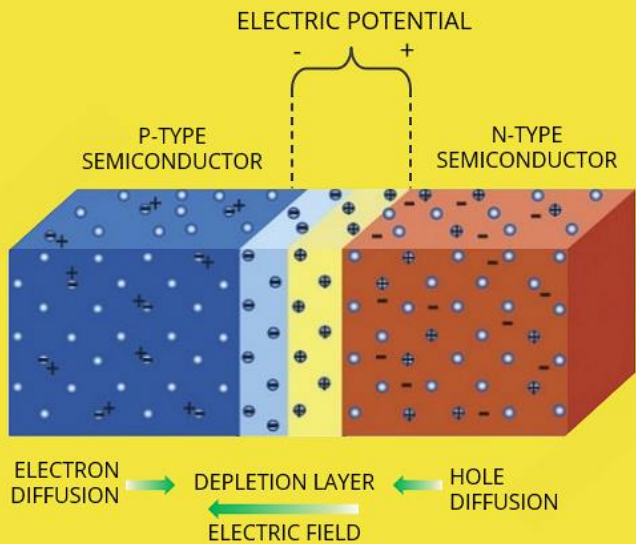
More useful life, less electronic waste





# 03

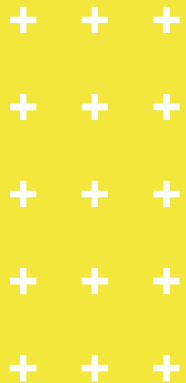
## Working Principle of Solar Panels



A solar panel works by converting light energy into electricity through the photovoltaic effect.

The principle of operation of these is using a semiconductor.

A semiconductor can absorb light and convert it into electricity.



A semiconductor is composed of three regions:

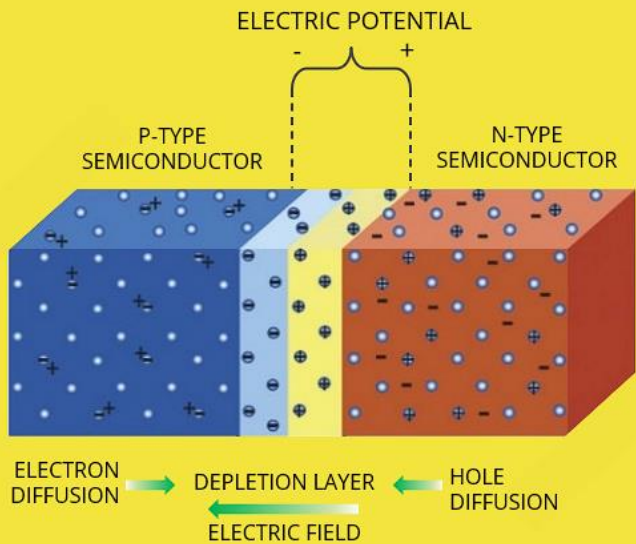
- N region.
- P region.
- Depletion region.





# 03

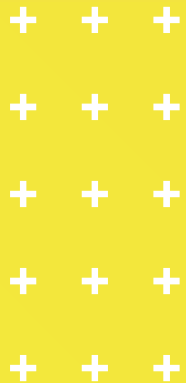
## Working Principle of Solar Panels



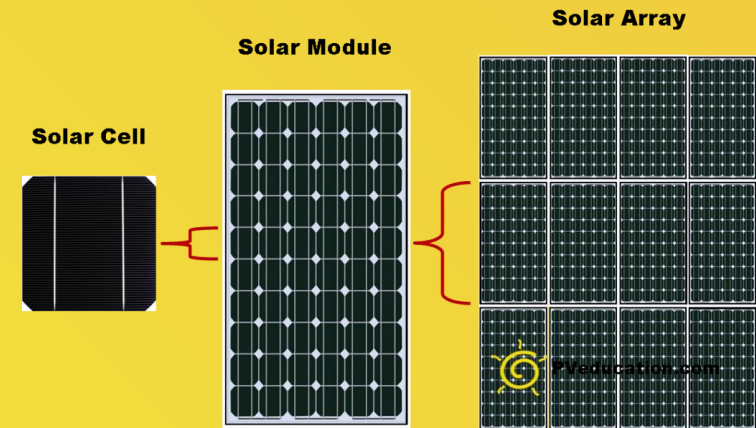
A small shift of electrons creates a depletion region.

Due to this, the N side is positively charged, and the P side is negatively charged.

Producing a potential difference and this induces an electric field.



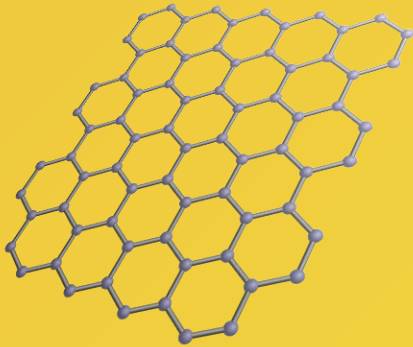
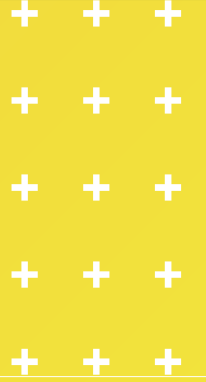
A solar panel is made up of many photovoltaic cells





# 04

## Improvements to Solar Panels with Graphene

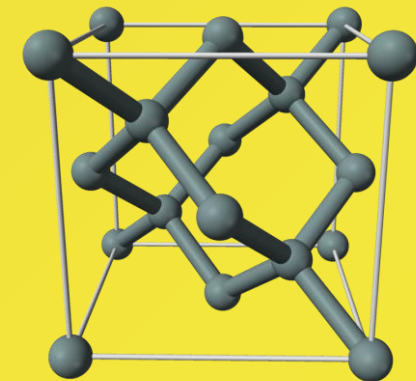


Solar panels can be improved by means of graphene and silicon.

Graphene acts as a transparent conductive electrode which collects carriers generated by other semiconductors.

Silicon has excellent light absorption and easy manufacturing process.

Due to this, graphene is a good alternative to produce Graphene-Silicon (G-Si) solar cells.

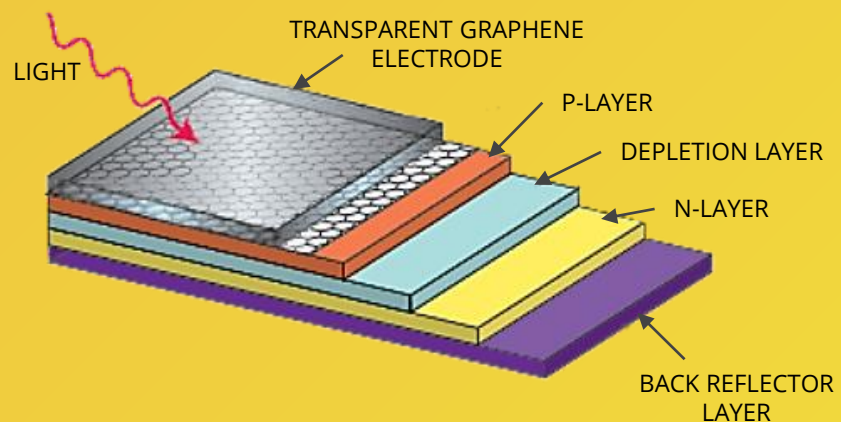






# 04

## Improvements to Solar Panels with Graphene



Researchers have managed to improve graphene-silicon (G-Si) photocells by including carbon nanotubes (CeG-Si).

They have also added anti-reflective materials to increase the light absorption of the solar cells.

The best obtained graphene-silicon solar cells have seen power conversion improvements of up to 15.2%.



# Conclusion

Graphene is not totally profitable for the current industry.

Improving the different current batteries and panels can contribute to their use in multiple applications.

An increase in the efficiency of solar energy systems, which could satisfy the present demands.

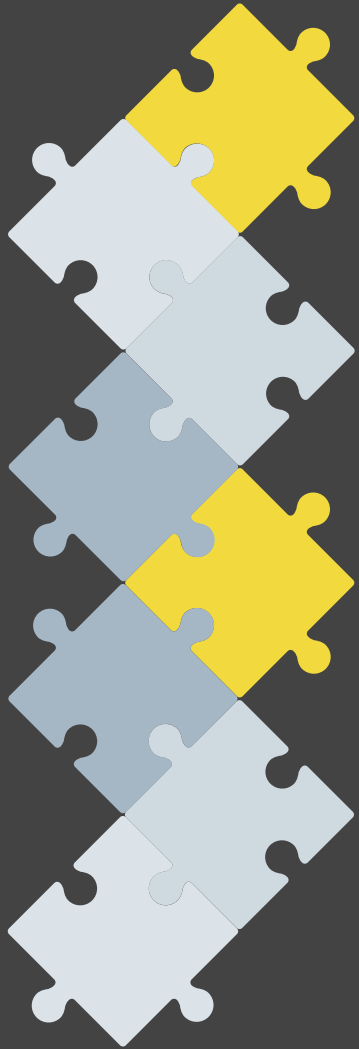
It is expected that:

- New methods may reduce the costs of production.
- New technologies may provide a better sustainable use of energy.



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# Thanks!

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