

The background of the slide is a photograph of a university campus. A wide, paved walkway leads from the foreground towards a large, modern building with a grid-like facade. The walkway is flanked by green lawns and several tall, thin, conical evergreen trees. The sky is clear and bright.

# **Application of Fullerene (C<sub>60</sub>) As interlayer in Perovskite Solar Cells**

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# Introduction

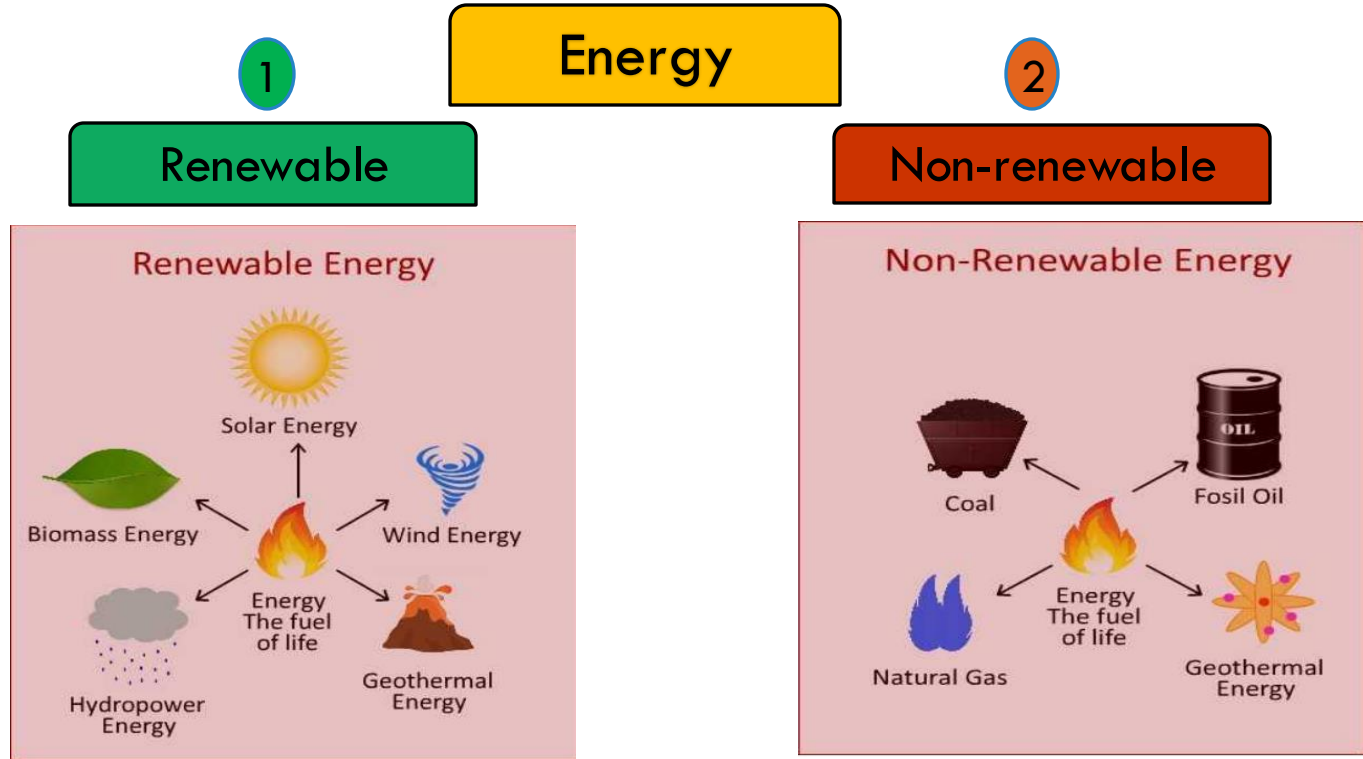
**Topics that will present here are:**

- **Future of energy**
- **Solar cells**
- **Perovskite solar cells (PSCs)**
- **Our results**
- **Recommended future works**

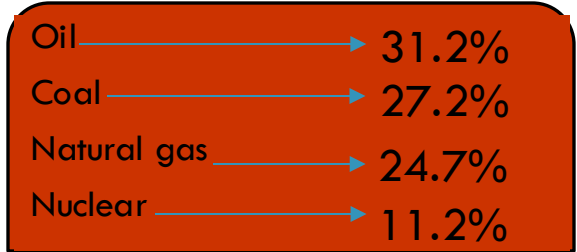
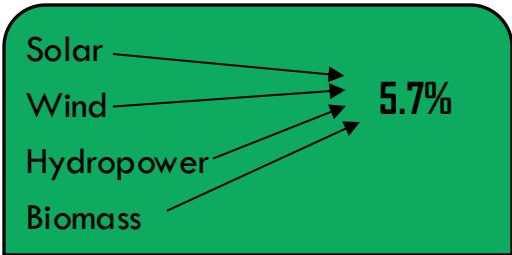
# Energy

## According to Feynman :

Energy is a certain quantity that does not change in the manifold changes which nature undergoes.

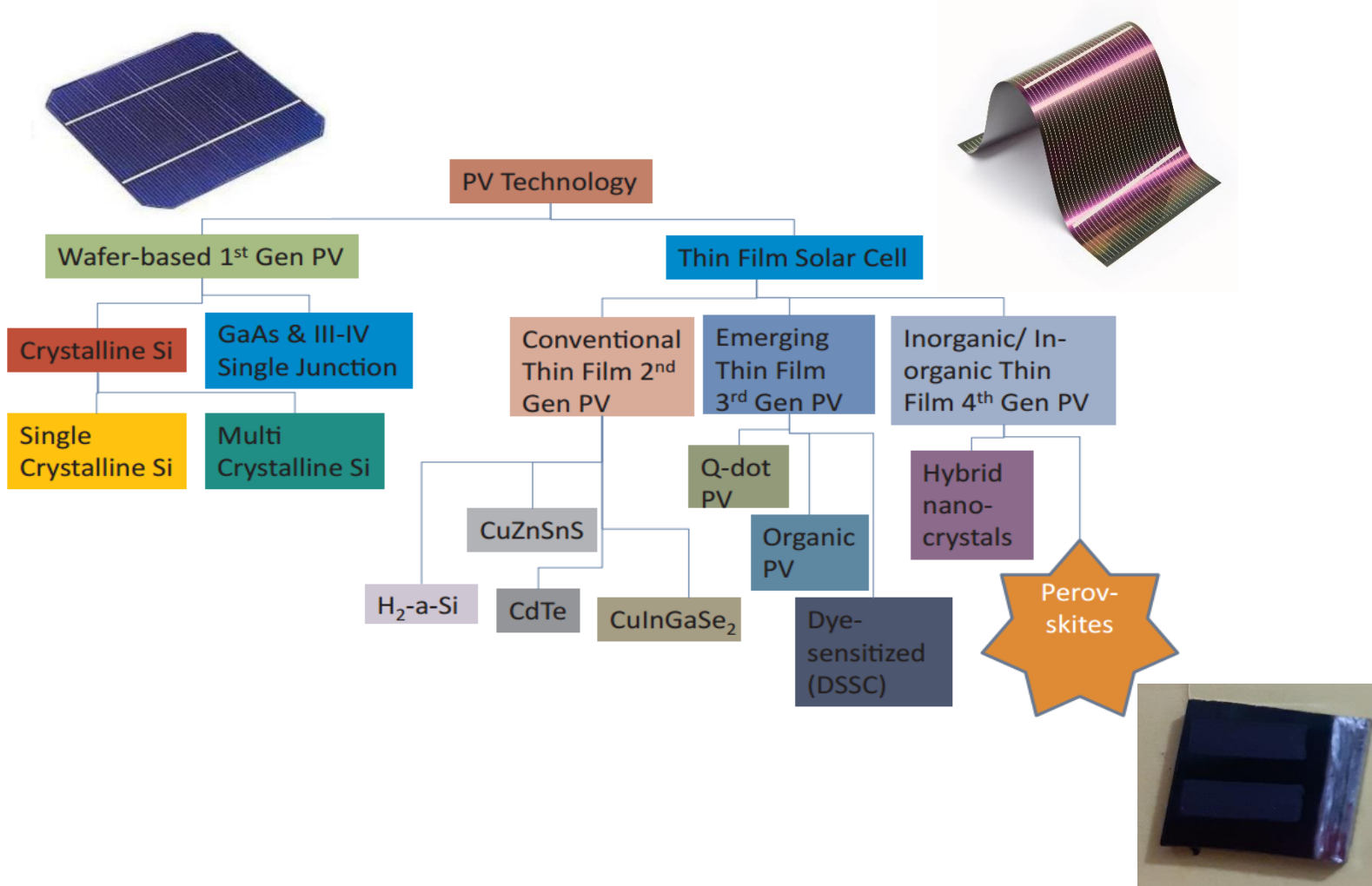


### Energy Consumption worldwide



# Solar cells

Devices that convert sunlight energy directly into electricity.

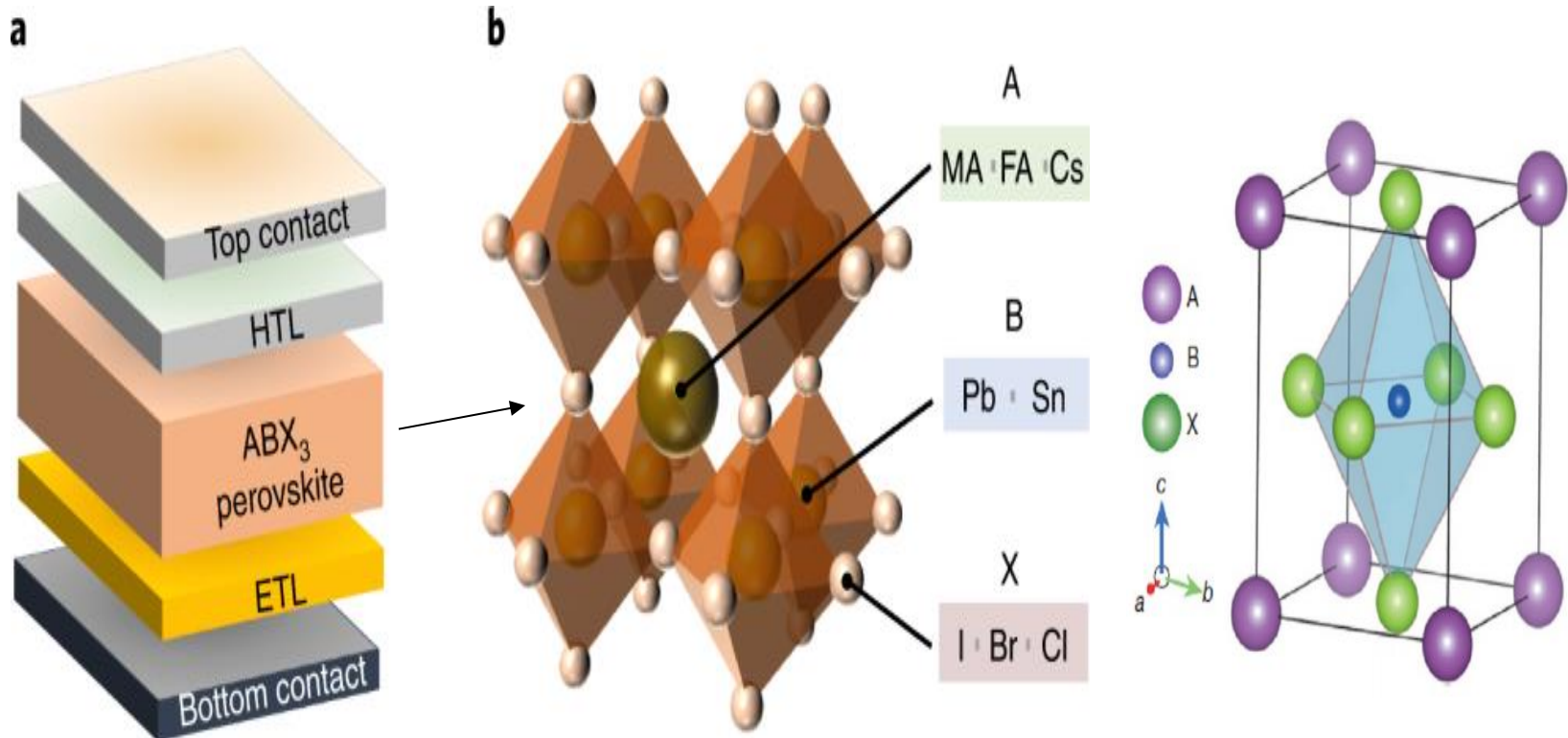




# Perovskite Solar Cells

Perovskite solar cells consist of the following layers

- ① Glass+FTO
- ② Electron transport layer (ETL)
- ③ Light absorbing material (perovskite layer)
- ④ Hole transport layer (HTL)
- ⑤ Metal electrode (Ag, Au, Al, Cu and ...).



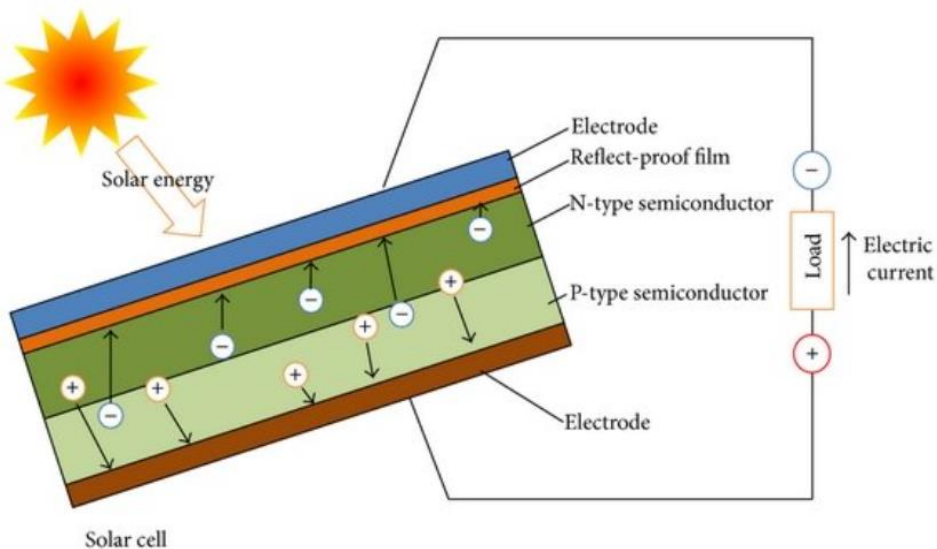


# Working principles of solar cells

## Homo-Junction

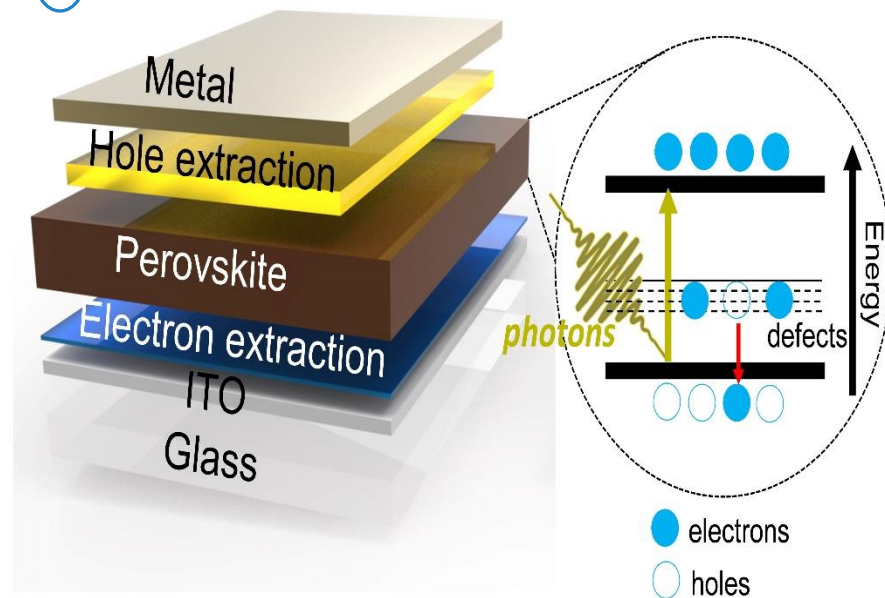
- ① Shining light on the active layer
- ② Generating electron-hole pair
- ③ Due to internal electric field electrons move to n-type material and holes move to p-type

material



## Hetero-Junction

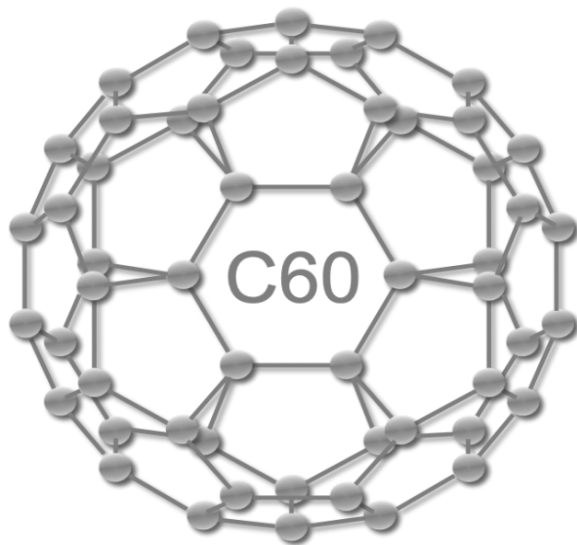
- ① Shining light on the complete cell
- ② Generating electron-hole pair (Perovskite layer)
- ③ Electrons extracted by (ETL)
- ④ Holes are extracted by (HTL)



# Fullerene C60 Bucky balls

- Like diamond and graphite, fullerene is a carbon allotrope
- It was discovered in 1985 H.Kroto, R.Smalley, R.Curl by vaporizing carbon in Helium atmosphere
- It consists of 60 carbon atoms
- Here we use it as PSCs interlayer because we are able to modify it so tiny around 20nm

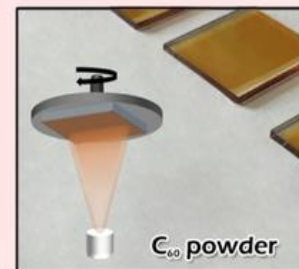
## Molecular structure



## Solution (C60 powder in Chlorobenzene)



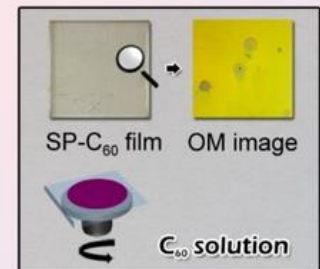
## Spin-coating VS Thermal evap deposition of C60



### Thermal Evaporation

- **Advantages:**
  1. Perfect morphology
  2. Finely controlled
  3. High performance
- **Disadvantages:**
  1. High cost
  2. Complicated operation

VS.



### Spin-Coating

- **Advantages:**
  1. Low cost
  2. Convenient operation
- **Disadvantages:**
  1. Poor morphology
  2. Roughly controlled
  3. Low performance



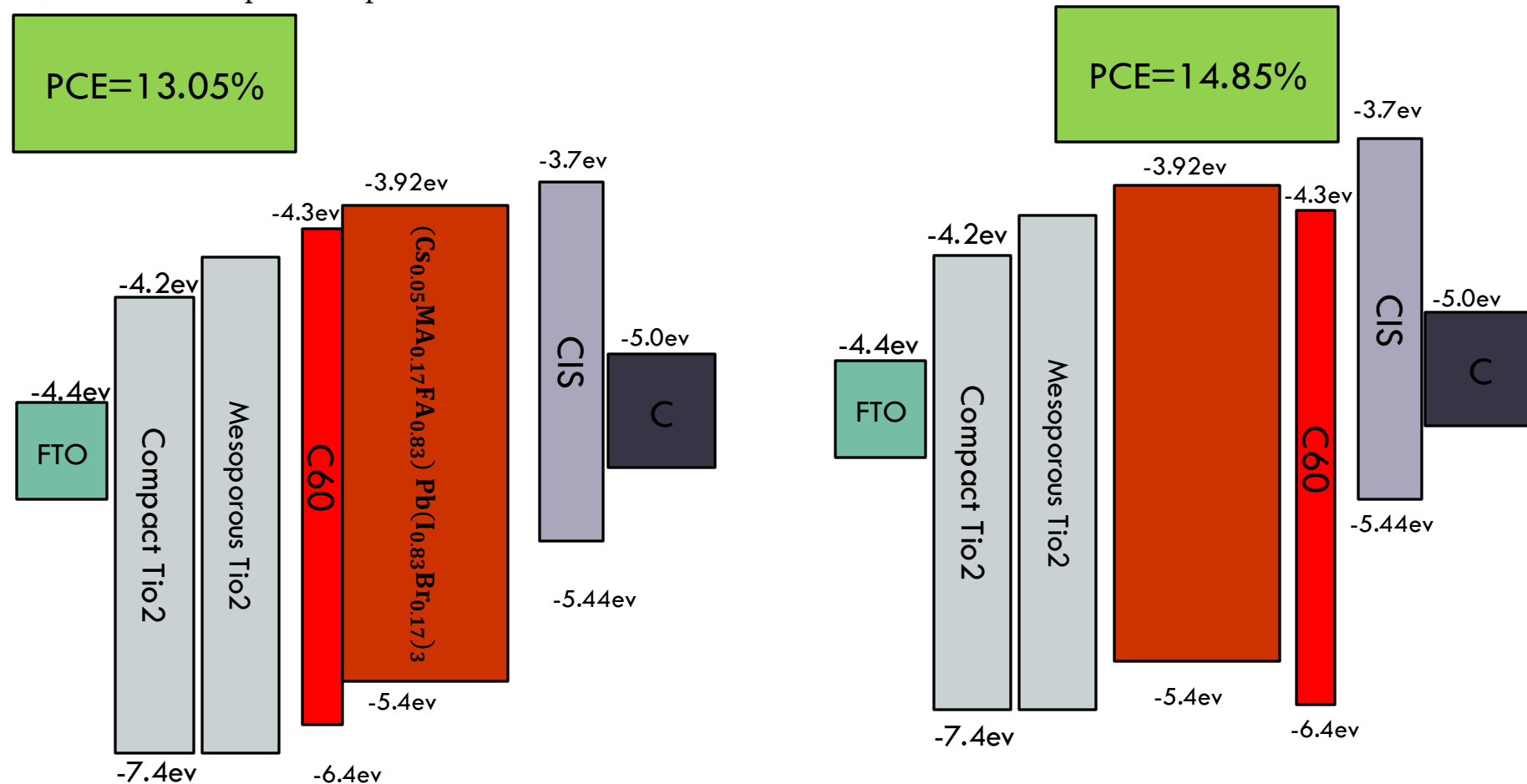
## Our work

### We apply Fullerene (C60) in three different situations

- As interlayer of ETL/Perovskite layers
- As interlayer of perovskite/HTL layers
- Bare complete perovskite cell

PCE=13.05%

PCE=14.85%





Thank you for your attention

