



Nano-Solar Research and Applications

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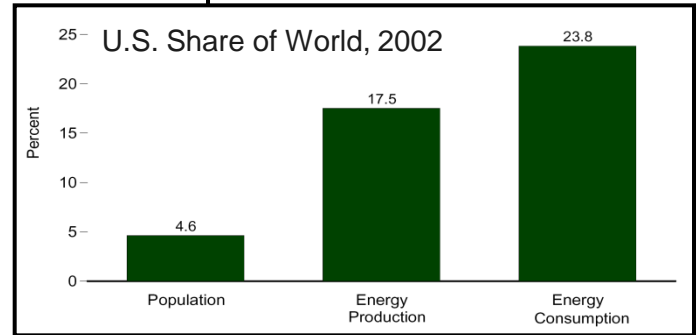
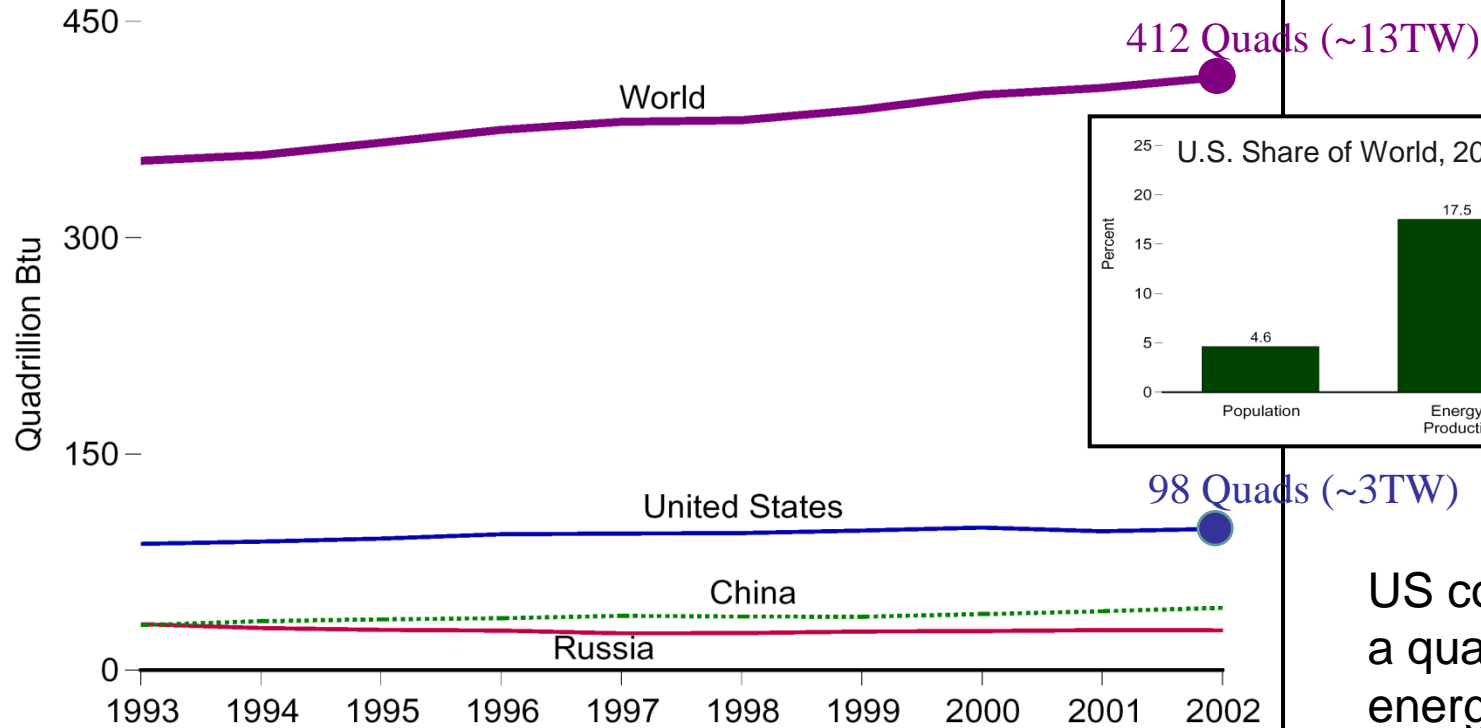


BIOMEDICAL & NANOTECHNOLOGY LAB



U.S. and World Energy Consumption Today

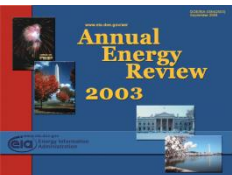
World and Leading Consumers, 1993-2002



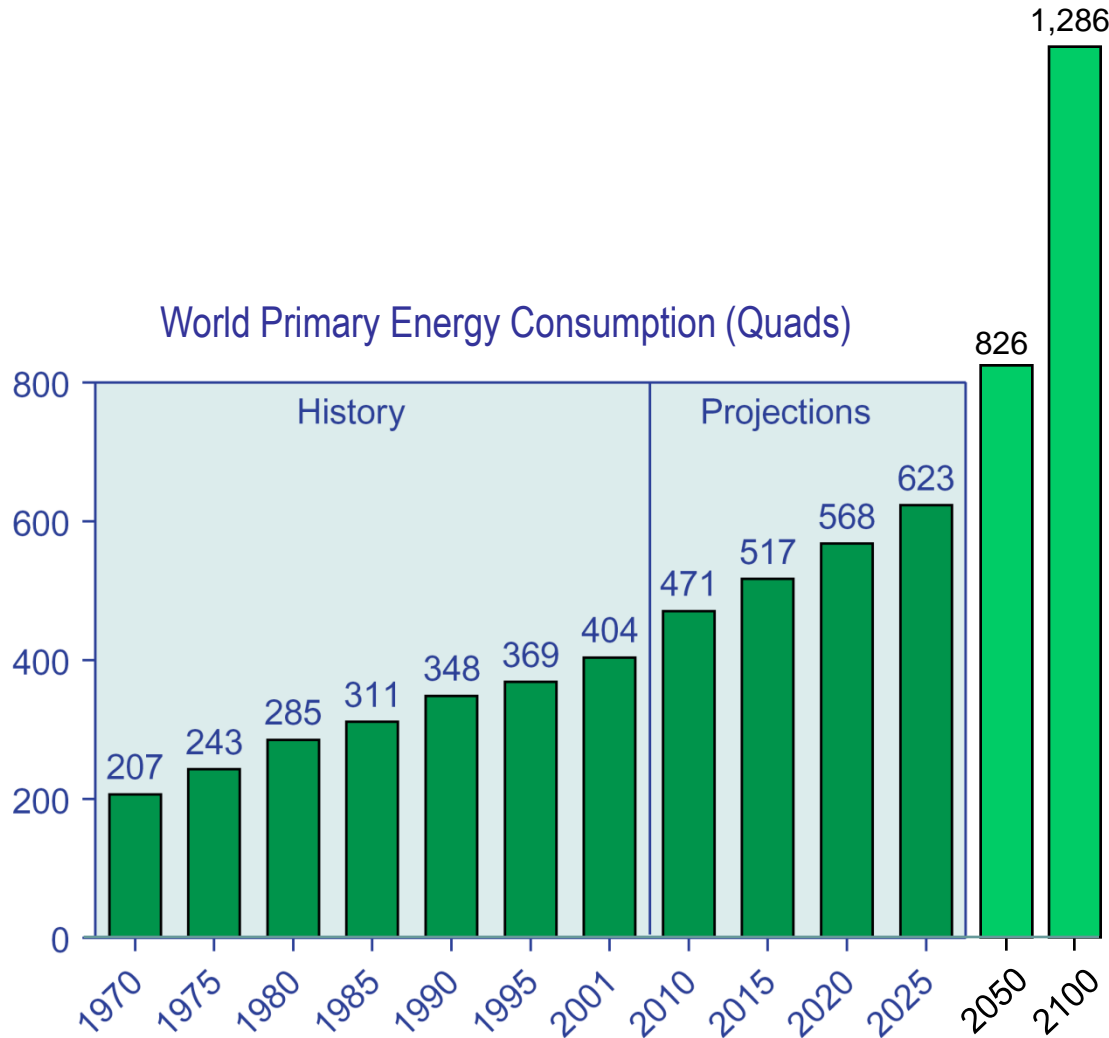
US consumed a quarter of global energy consumption in 2000.

Some equivalent ways of referring to the energy used by the U.S. in 1 year (approx. 100 Quads)

- 100.0 quadrillion British Thermal Units (Quads) U.S. & British unit of energy
- 105.5 exa Joules (EJ) Metric unit of energy
- 3.346 terawatt-years (TW-yr) Metric unit of power (energy/sec)x(#seconds in a year)

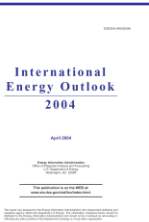


Projected World Energy Consumption in the Coming Century

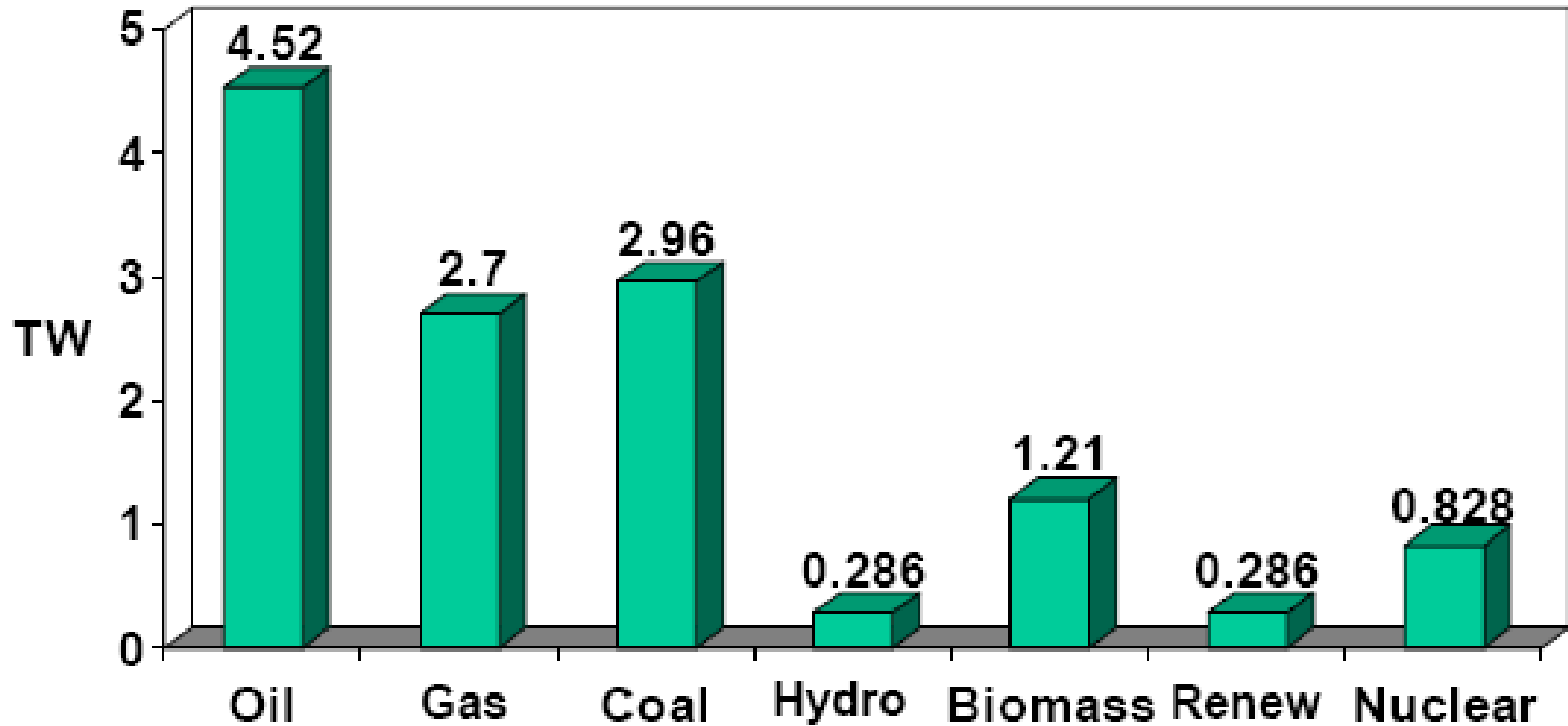


Projections to 2025 are from the Energy Information Administration, International Energy Outlook, 2004.

- Current global population is about 6 billion
- Estimated population in 2050 is about 10 billion people
- The projection of energy demand is 28 TW in 2050
- China and India are the major players due to their economical growth



Breakdown of Energy Technologies Used Today

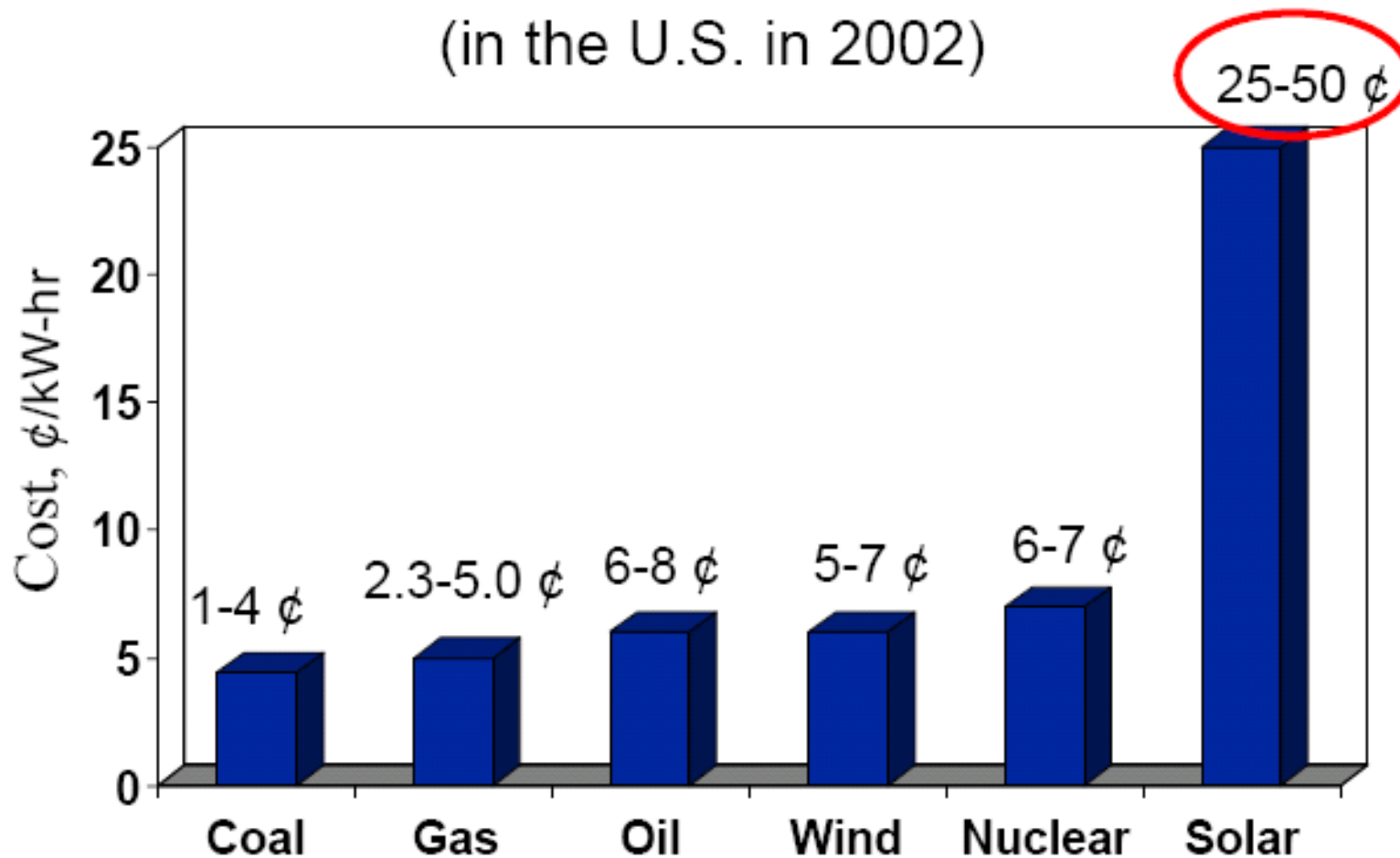


The 28 TW Question?

- **NUCLEAR** – Current capacity is 1GW. To produce 10TW power 10,000 new nuclear plants needed.
 - Need to open 1 new nuclear plant every other day until 2050.
- **WIND** – Already cheap at \$ 0.05/kWh
 - 27% of the earth's land is rated as class three with respect to wind electric potential.
 - Total electrical power potential is about 2TW.
- **BIOMASS** – Biomass is very inefficient because plants using photosynthesis only store <1% of the total incident energy that they receive from sunlight.
 - 20 TW of power requires 31% of total land area on earth.
- **GEOTHERMAL** – Very limited
- **SOLAR** – Only renewable has potential to satisfy 20TW carbon-free supply by 2050.

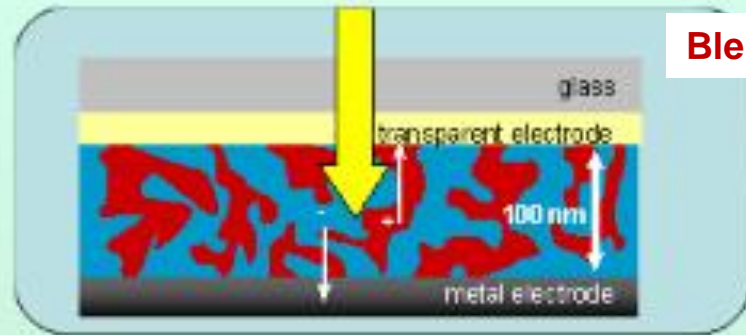
Today: Production Cost of Electricity

(in the U.S. in 2002)



1888 - [Edward Weston](#) receives patent US389124, "Solar cell", and US389125, "Solar cell"

Interpenetrating Nanostructured Networks



Blend of D-A

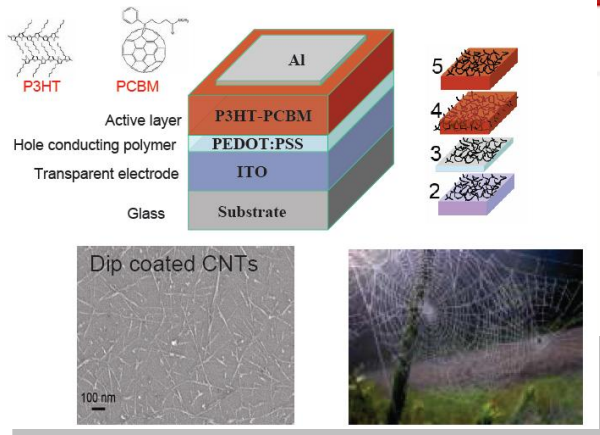
A diagram and photograph of a dye-synthesized solar cell. The diagram shows a cross-section with layers: "Conducting glass substrate", "Pt/nano", "Dye-sensitized mesoporous TiO₂", "Oxide electrolyte", and "TiO₂ substrate". A circuit diagram shows a load and a voltmeter. Below the diagram is a photograph of a person holding a flexible solar cell panel.

Dye-synthesized (TiO₂)

A diagram and photograph of hybrid nanostructures. The diagram shows a cross-section with layers: "ITO", "TiO₂", and "Hybrid nanostructures". An inset shows a scanning electron micrograph (SEM) of the nanostructures. Another inset shows a schematic of the hybrid nanostructure with a vertical rod and a horizontal layer of molecules.

Hybrid nanostructures

NANO-SOLAR TECHNOLOGIES in UCR

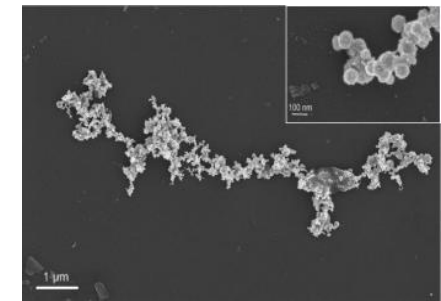
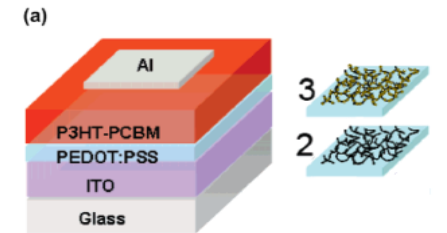


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Doubled the state-of-the-art conversion efficiency up to 4.9%

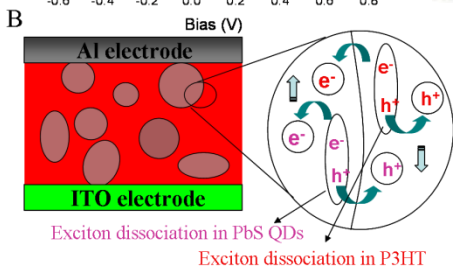
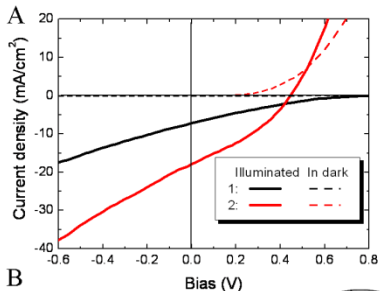
w/DNA 12% increase w/Pt-DNA %25 increase



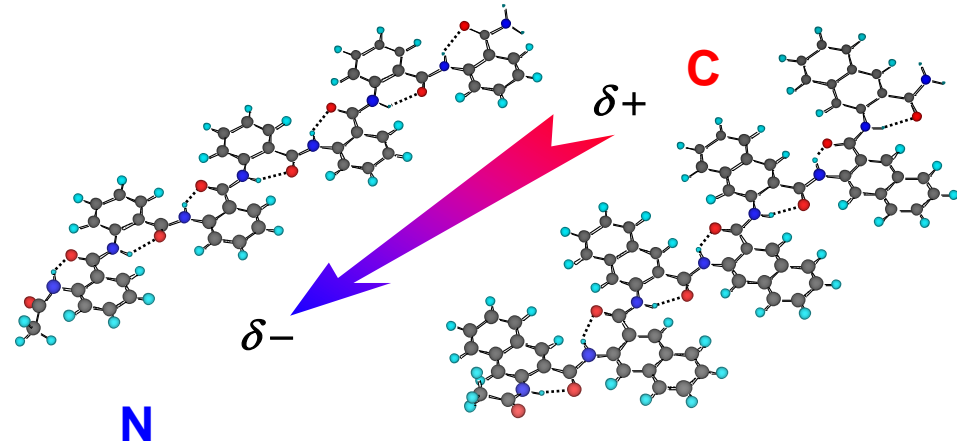
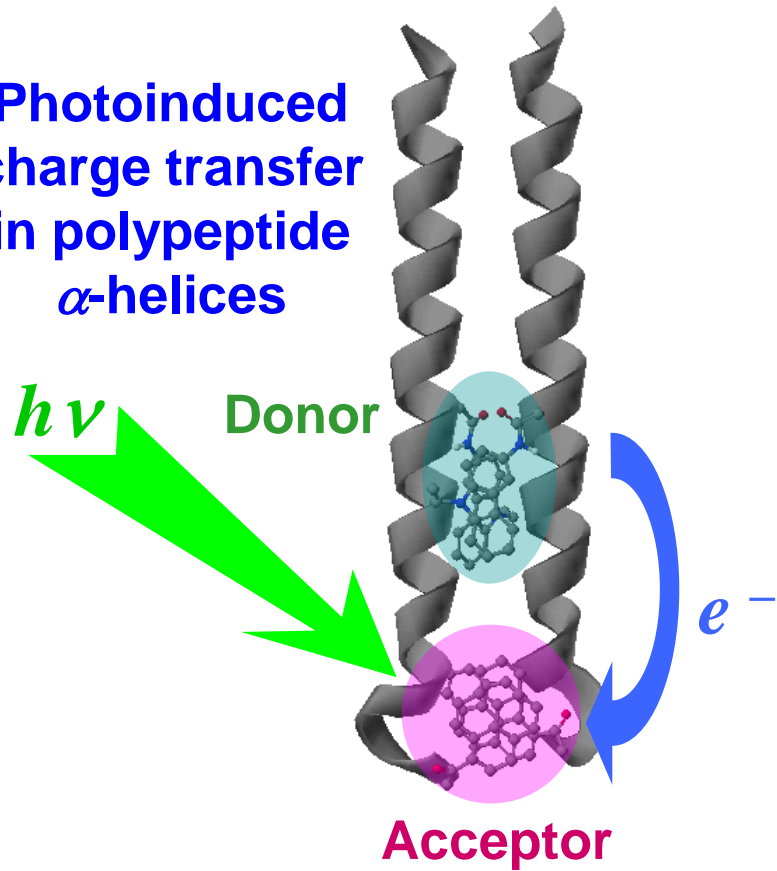
M.Ozkan, C.Ozkan

power conversion efficiency was enhanced as high as 160% (under AM 1.5G, 1 sun illumination) compared to that of pure P3HT polymer.

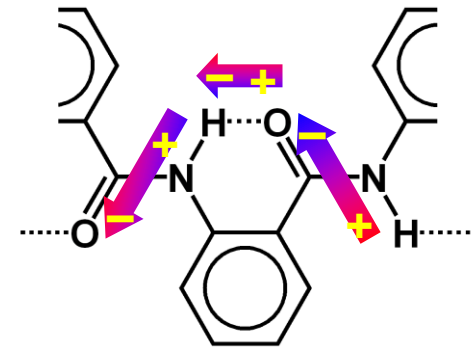
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Photoinduced charge transfer in polypeptide α -helices

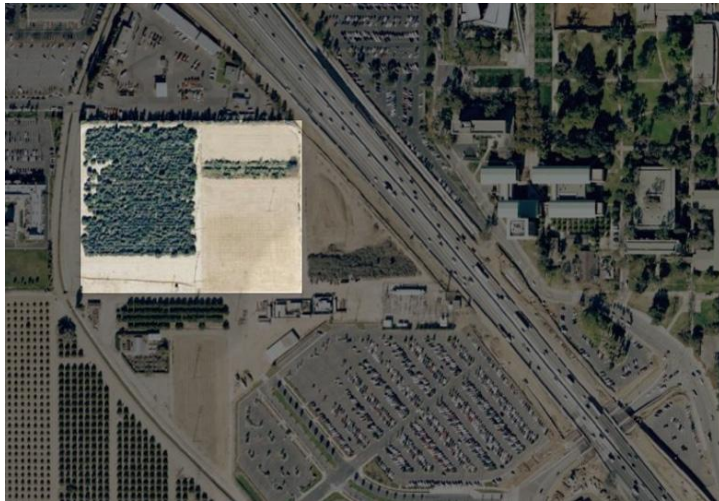


Bioinspired electrets

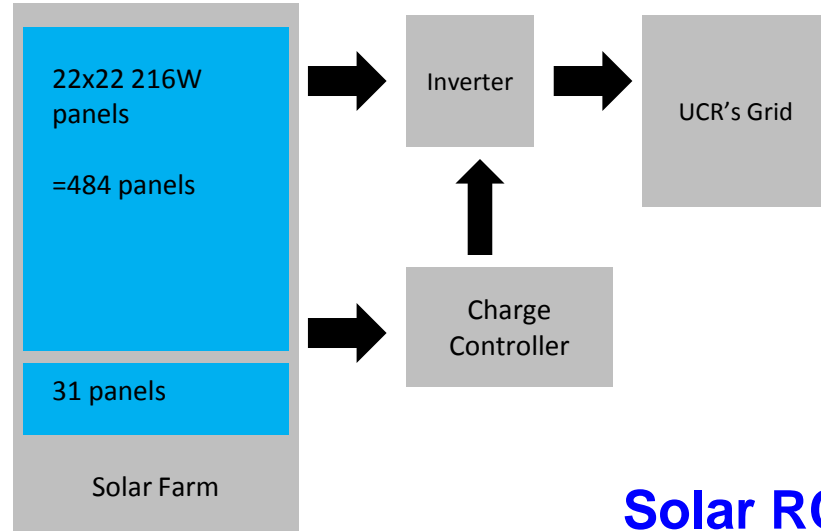


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Training of Next Generation in UCR



1 MW Solar Farm in UCR



Solar RC Car



Solar backpack



Solar Cell Fabrication



Solar Tracking System



Solar Display

1932 – Fossil Fuels



Reykjavik: The capital and largest city of Iceland

Present Day – Geothermal Energy

