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(An Autonomous Institute, Affiliated to Savitribai Phule Pune University, Pune)

NAAC 'A' Grade Accredited, ISO 9001:2015 Certified

DEPARTMENT OF ELECTRICAL ENGINNERING

PROJECT- SOLAR POWER

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INTRODUCTION

Solar power is one of the most promising and cleanest sources of renewable energy. It converts sunlight into electricity using technologies like solar panels and photovoltaic cells.

With growing energy demands and rising environmental concerns, solar power is becoming a key solution for sustainable development. It reduces dependence on fossil fuels, lowers carbon emissions, and provides an infinite supply of energy directly from the sun.

How Solar Cell Works?

A solar cell works on the photovoltaic effect:-
The process by which light energy (photons) is converted into electrical energy.

Sunlight Hits The Cell	Electron Hole Pair Generation	Separation By Electric Field	Current Flow	Power Output
Protons strike the semiconductor surface.	The energy from photons excites electrons in silicon atoms, freeing them & leaving behind "holes".	The built in electric field at the PN junction pushes electrons towards the n-side & holes towards the p-side.	Due to this movement, electrons flow through the external circuit producing direct current(dc) electricity.	Multiple solar cells are connected to form a solar panel, increasing power output.

PHOTOVOLTAIC SOLAR PANEL

Solar Energy

Type of solar cell & Efficiency

Perovskite Solar Cells:-

- Use hybrid organic–inorganic perovskite materials
- Easy to manufacture, lightweight & flexible
- Efficiency: ~25% (rapidly improving)

Organic Solar Cells (Polymer-based)

- Made of carbon-based materials
- Thin & flexible, low cost, eco-friendly
- Efficiency: ~10–15%, less stable

Dye-Sensitized Solar Cells (DSSC)

- Use dye molecules + electrolytes to absorb sunlight
- Work well in low-light conditions, semi-transparent
- Efficiency: ~11–13%, low-cost

AI Transforming Solar Energy: Smarter, Faster, Better Precise Forecastin

1.Material Discovery:- AI predicts new semiconductor materials (like stable perovskites, organic molecules, quantum dots).Saves years of trial-and-error lab work.

2.Efficiency Optimization:-Machine learning models suggest best chemical compositions, doping levels, and coatings to increase light absorption.

3.Process Control in Fabrication:-AI optimizes thin-film deposition, coating uniformity, and nano-structuring in real time.

4. Solar-to-Fuel Chemistry:-AI guides the design of photocatalysts for water splitting (green hydrogen) and CO_2 reductionAI optimizes thin-film deposition, coating uniformity


Robotic cleaners
AI- vision for dirt & hotspot detection
Waterless cleaning robots
AI-based cleaning technology
Drones with soft-brush cleaning
Electrodynamic dust-removal films
Sensor-based automated sprayers

AI Used in other countries

USA Uses AI for solar power forecasting, fault detection, and grid management.China: Uses AI-powered drones for monitoring huge desert-based solar farms.Germany: Uses AI in smart-grid integration and energy storage optimization.Japan: Uses robotics + AI for cleaning and monitoring floating solar plant

Current AI projects in india

India is becoming a leader too:• India’s first AI-powered solar manufacturing plant (Goldi Solar, Gujarat).• NTPC uses AI models for predictive maintenance in large solar parks.• Indian startups developing AI cleaning robots for dusty regions.• Research labs working on AI + perovskite material discovery.• Smart grid projects using AI for power scheduling and load balancing.

Harnessing the Sun: Solar Energy in the UAE

- Solar plants that works in presence of sunlight.
- But the UAE(United Arab Emirates) started building the world's first & largest solar plant that works 24/7.

- Solar power has a problem it always need the sun, when the sun goes down then there is no power generation, when its a cloudy day then also power not generates.
- So that the engineers from masdar and emirates water & electricity company(EWEC) came up with a solution.

- What if we add a giant battery to the solar power plant?
- A battery that charges during the day & releases power at night.That's the idea

- Abu dhabi broke the ground on a 5.2 gigawatt solar plant with the world's largest battery which occupy 10 million of cells put together.
- Using this solar plant they get 1 gigawatt of energy consistently at 9am, 12pm, 5pm & 9pm.

- There is still energy even if it's cloudy or it's night.
- This solar plant will gives power approximately ten millions homes in Abu Dhabi and it will also power chatgpt.
- When you ask chatgpt a question in Abu Dhabi, the response will use green energy.

- You may think that it is very expensive but this solar energy will be cheap.
- This battery idea also works for wind farms. They can supply energy even without wind.
- Using solar plant, we get clean energy 24 hr a day, 365 days a year


This will be

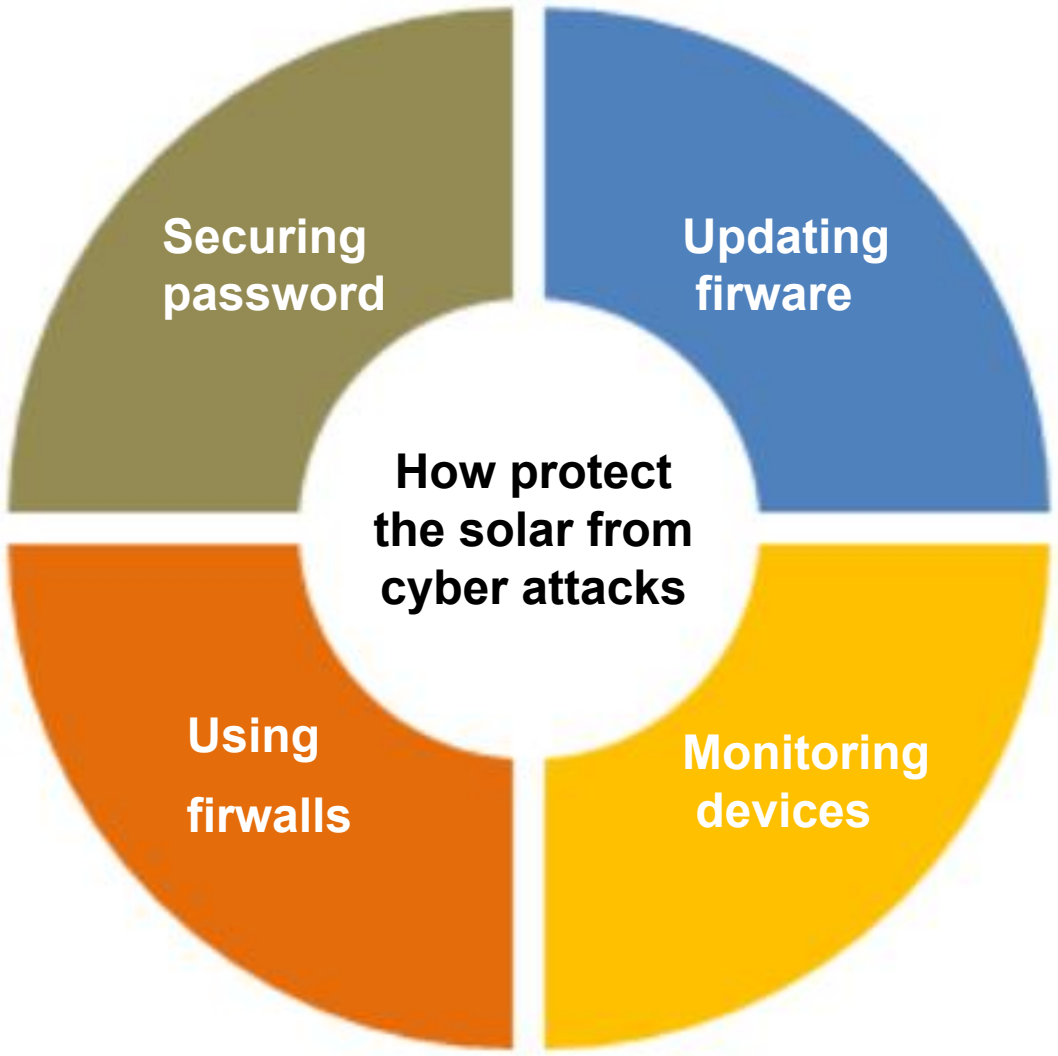
Protecting solar energy in the digital age

Solar plant use

1. OT devices
2. Sensors
3. Smart meters
4. Inverters

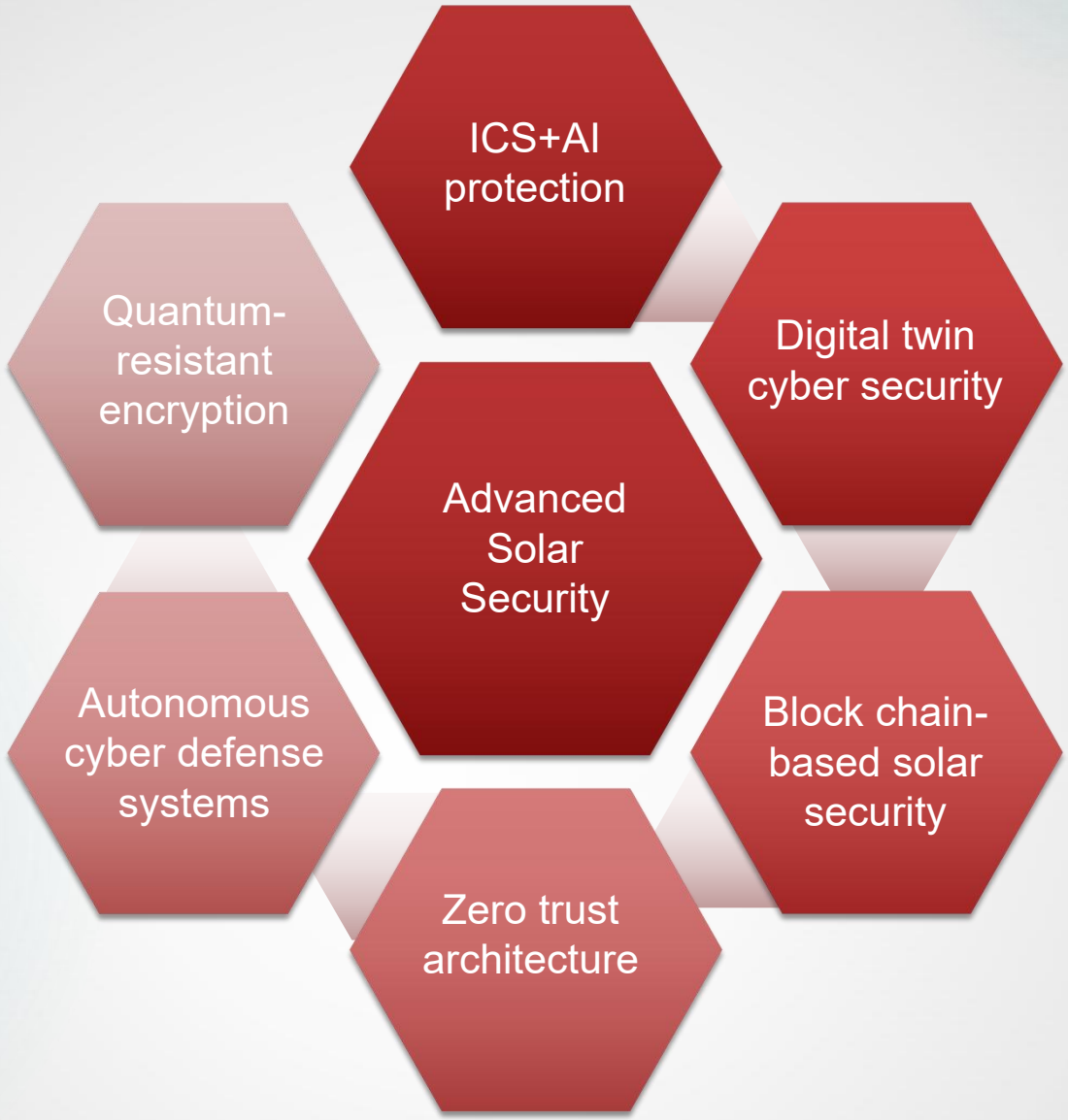
If Hackers attack a solar plant

1. They can shut down solar inverters
2. Change volatage level
3. Damage equipment
4. Cause blackout in the grid



SCADA SYSTEM (**Supervisory control and data acquisition)**

SACDA is system that collect data from solar equipment using sensors and controllers, displays it in a control room, and allow enginrrrs to monitor and control the entire solar plant remotrly.


ICS+AI protection
Quantum-resistant encryption
Digital twin cyber security
Advanced Solar Security
Autonomous cyber defense systems
Block chain-based solar security
Zero trust architecture

Environmental Imapact

Role of Electrical Engineers

- Design and install solar power systems.
- connect solar panels to the electrical grid.
- Improve efficiency of solar cells and inverters
- Develop safe and reliable storage (batteries)

- Maintain and monitor solar plants.
- Work on smart grids and solar integration.
- Ensure safety, stability, and cost-effectiveness.
- Develop solar-powered EV charging systems

FUTURE TRENDS

More efficient solar cells

Building-integrated solar panels

3.Floating solar farms on lakes and reservoirs.

3.Solar-powered EV charging stations Smart grids with AI for solar energy management.

Solar + energy storage

3.Eco-friendly and recyclable solar materials.

APPLICATIONS

Rural Electrification and Social Development

India has thousands of villages where electricity supply is weak or absent. Solar home systems and microgrids are used to provide electricity for lighting, charging, and small appliances. Example: Many villages in states like Bihar, Jharkhand, and Assam now use solar microgrids

Agriculture and Farmers' Benefits

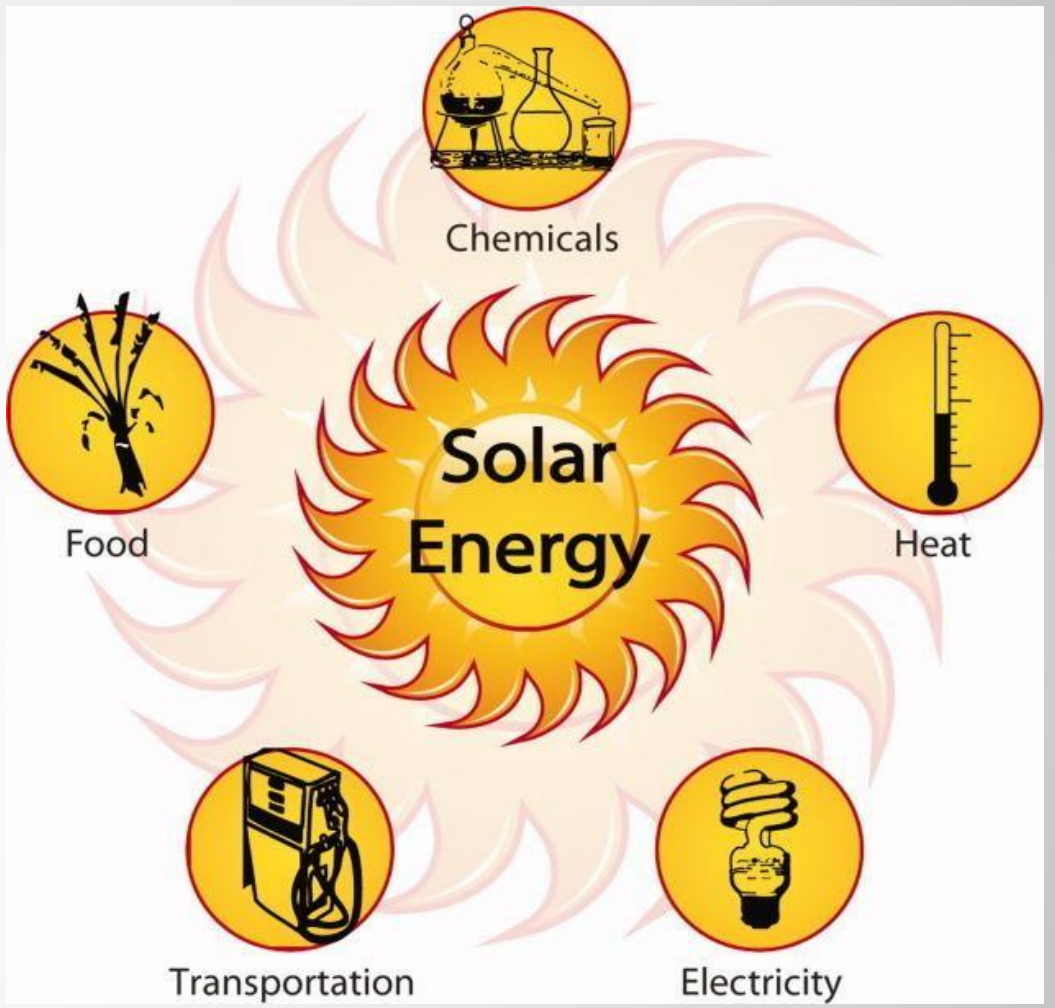
Farmers use solar water pumps for irrigation instead of diesel or electricity pumps. This reduces cost and pollution. Solar dryers help preserve fruits, vegetables, and grains by removing moisture.

How solar cells are used in vehicles in India

Someresearch projects and startups in India are designing cars, buses, and auto-rickshaws that have solar panels mounted on top. The solar cells convert sunlight into electricity, which charges the battery of the vehicle and run the vehicals

Use of Solar Cells in Satellites

Satellites that move around the Earth (like communication satellites, weather satellites, GPS satellites, etc.) need electric power to work. But in space, there are no electric wires or power stations. So, they use solar cells to make electricity from sunlight. In space, sunlight is very strong and always available



BENEFITS

1. **Renewable & Sustainable –** Unlimited energy from the sun.
2. **Eco-Friendly –** Reduces greenhouse gas emissions.
3. **Cost-Effective –** Saves electricity bills in the long run.
4. **Low Maintenance** – Solar panels require minimal upkeep.
5. **Energy Independence –** Reduces dependence on fossil fuels.
6. **Job Creation –** Solar industry provides employment opportunities

LIMITATION

1. **Weather –** Less efficient on cloudy or rainy days.
2. **High Initial Cost –** Installation can be expensive.
3. **Energy Storage Required –** Needs batteries or backup for night use.
4. **Large Space Requirement –** Solar farms need wide land areas.
5. **Efficiency Limitations –** Panels convert only ~20–25% of sunlight.
6. **Material & Recycling Issues –** Some solar materials are costly and hard to recycle.

Our Visit:

The feature of our project

1. Animal Detection System
2. Location Tracking Module
3. Built-in Air Compressor
4. Temperature Monitoring Unit
5. LED Lighting for Night Use
6. USB Phone Charging Port

References:

1. MNRE – Ministry of New and Renewable Energy, Govt. of India
National Solar Mission reports & solar capacity data.

2. NREL – National Renewable Energy Laboratory (USA)
Solar PV basics, efficiency charts, and technology overview.

3. IEA – International Energy Agency
Global solar market outlook and renewable energy statistics.

4. SECI – Solar Energy Corporation of India
Solar park development, tenders, and project information.

5. NPTEL – IIT Lectures on Solar Photovoltaics
Concepts of PV cells, modules, and working principles.

6. IRENA – International Renewable Energy Agency
Renewable energy trends & global solar deployment.

7. PV Magazine & Mercom India
Latest industry updates, new technologies, and news articles.

CONCLUSION

Solar cells in India are not just about reducing electricity bills— they are about:

- Energy security (reducing dependence on coal and oil)
- Environmental protection (cutting pollution and greenhouse gases)
- Economic development (creating jobs in solar industry)
- Social improvement (providing power to rural and remote communities)


THANK YOU