



TSS COURSE ON

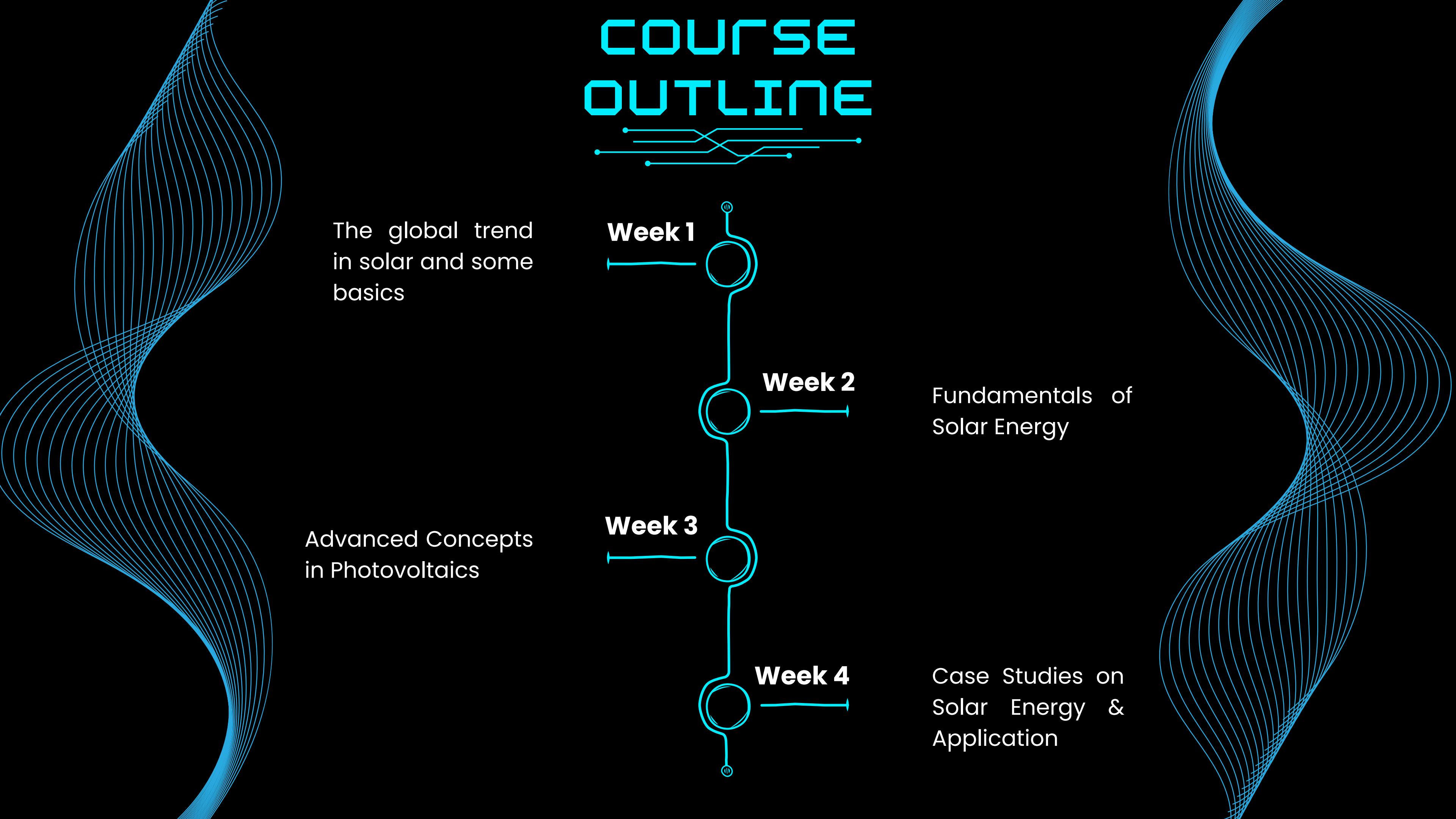
# SOLAR ENERGY & THE GLOBAL TRENDS



## TOPICS TO BE COVERED TODAY

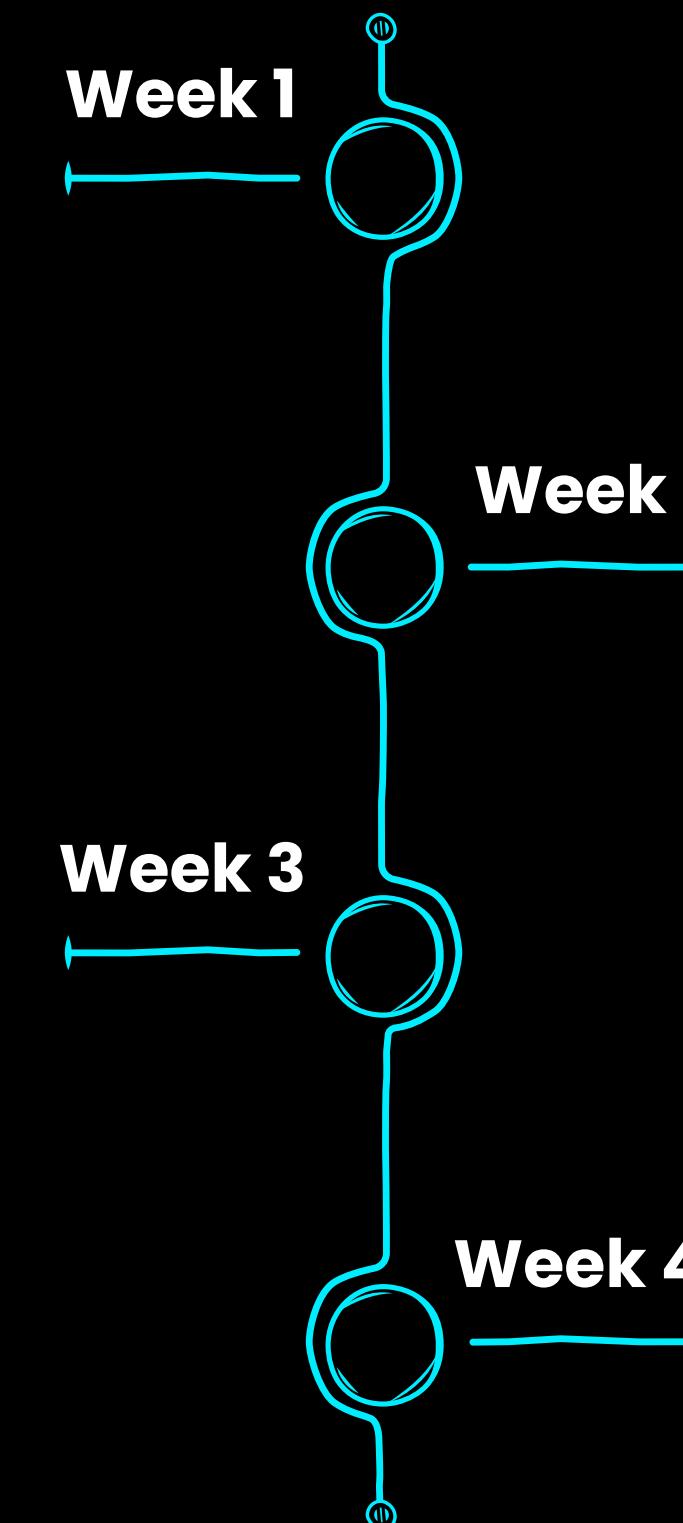
- Understand how solar cells generate electricity from sunlight
- Grasp the idea of the photovoltaic effect
- Know what semiconductors and band gaps are
- See what a p-n junction is and why it's used in solar cells

# COURSE OUTLINE



The global trend  
in solar and some  
basics

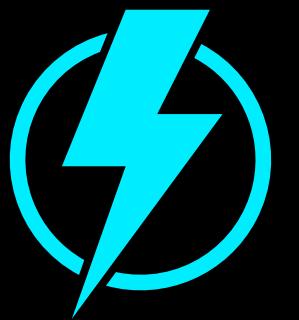
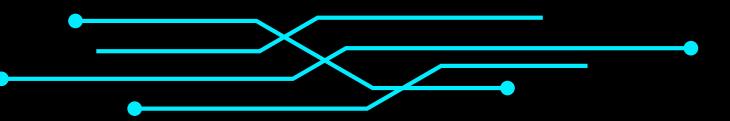
Advanced Concepts  
in Photovoltaics



Fundamentals of  
Solar Energy

Case Studies on  
Solar Energy &  
Application

# WHAT IS ENERGY



*"It is important to realize that in physics today, we have no knowledge of what energy is. We do not have a picture that energy comes in little blobs of a definite amount."*

— Richard Feynman

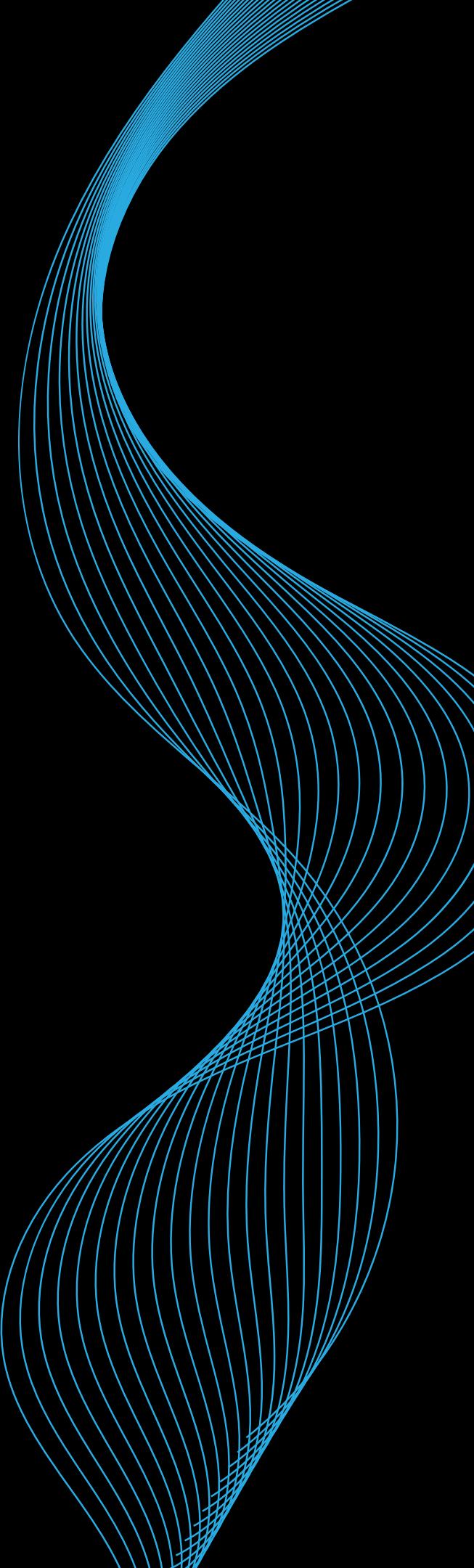


We use energy every day: to power lights, fans, phones, vehicles, industries.

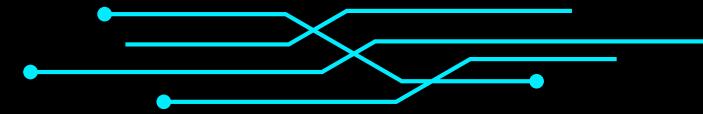
But in reality, energy is the ability to do work, to move things, heat them or create electricity.

According to the law of conservation of energy:

- Energy can neither be created nor destroyed
- It only changes form e.g., from sunlight to electricity



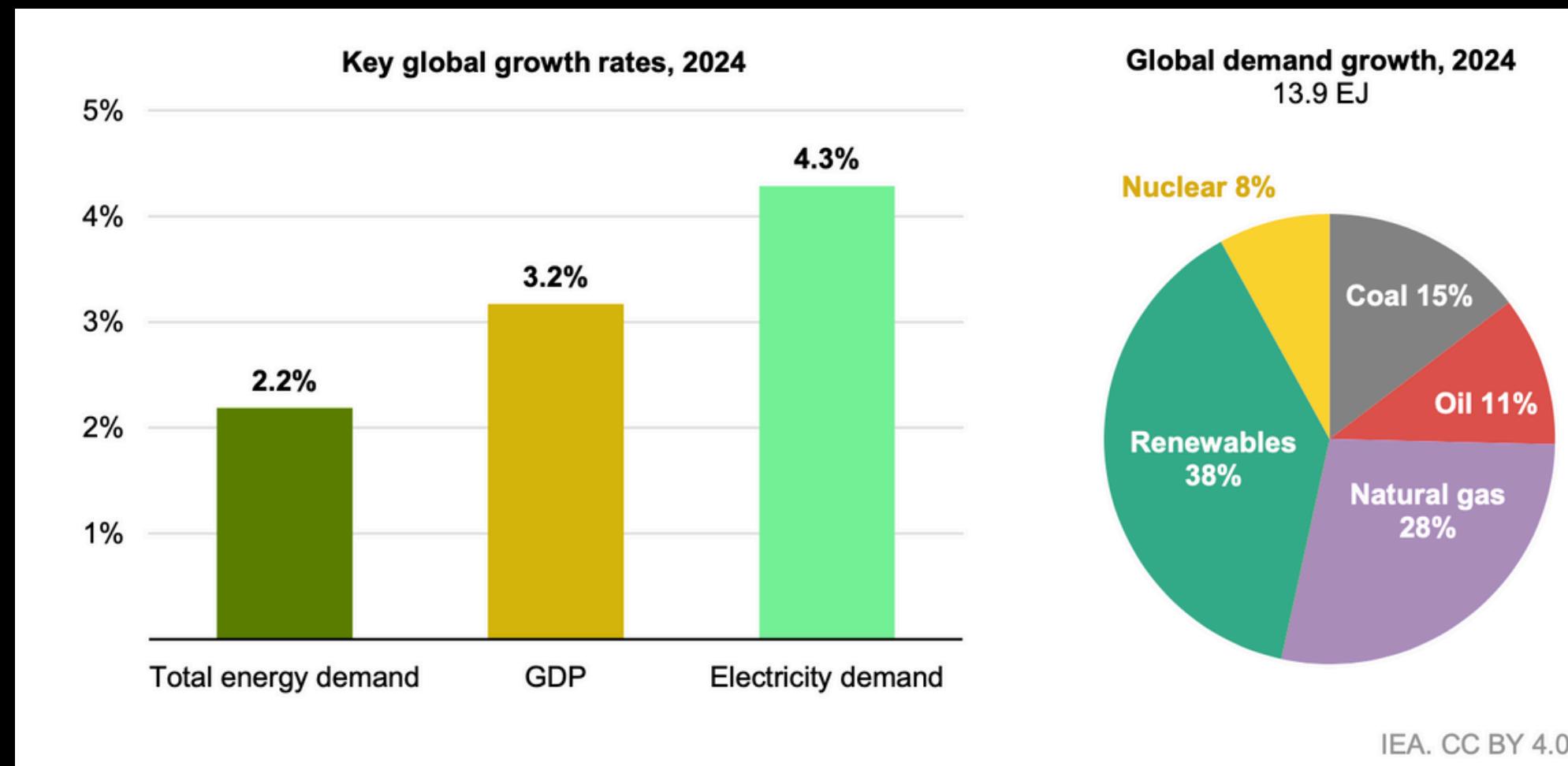
# ELECTRICITY



Electricity is the most flexible and widely used form of energy today. It powers homes, hospitals, schools, industries and the internet. Yet, its generation still depends mostly on fossil fuels like coal and oil.

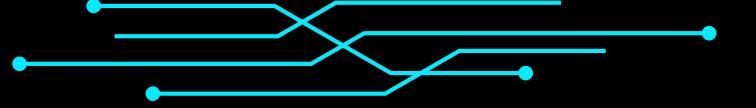
- Over 1.3 billion people (2009 data) lacked access to electricity
- The majority of electricity is still produced through combustion and steam a method that loses 50–60% of energy during conversion

*"The enormous progress of mankind is not just about more energy, but better use of energy."*



# Electricity demand grew more rapidly than both overall energy demand and GDP

# INDIA VS THE globe



The challenge: How can India grow its energy use without repeating fossil fuel dependence?

Most of our electricity today comes from burning coal, oil, and gas.

But this system is full of problems:

- Pollution : Burning fossil fuels releases CO<sub>2</sub>, causing climate change
- Depletion : These fuels take millions of years to form but are used up rapidly
- Import Dependence “ Countries like India import a large share of oil and gas
- Inefficiency : In coal plants, over 50% of energy is lost as heat

“The process of converting fossil fuels to electricity involves multiple steps, combustion, heating, steam generation and turbine rotation, each losing energy.”

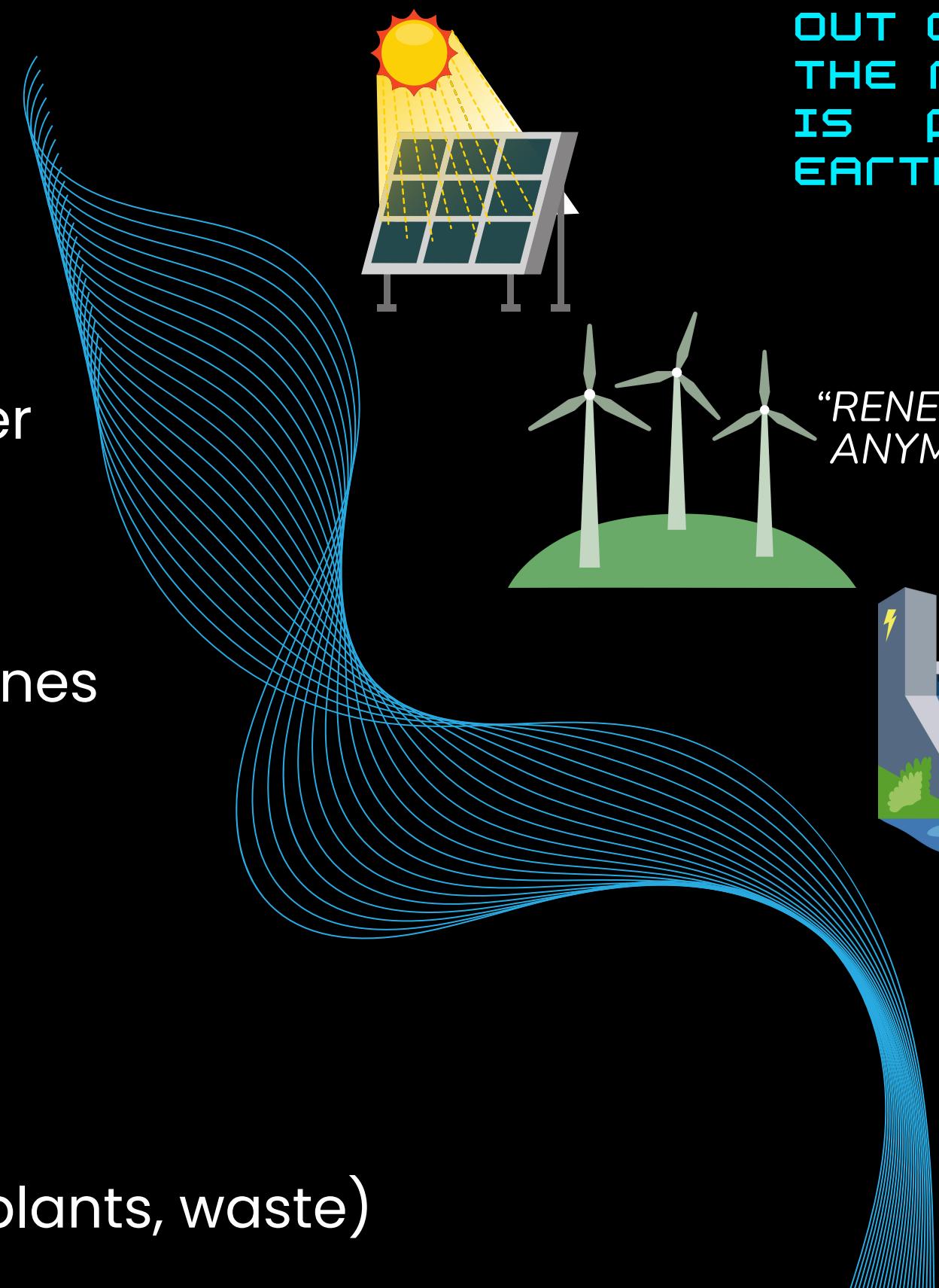
Not all countries use energy equally. In fact, the difference in energy consumption between countries is a direct reflection of development, technology use, and lifestyle.

Country	Power Use (W/person)
USA	9,319 W
Netherlands	6,160 W
China	2,695 W
India	797 W
Kenya	637 W

- An average American uses more than 11 times the energy an Indian uses
- India still has a huge gap to fill in energy access and equity

# RENEWABLE ENERGY SOURCES?

- **Solar** – Sunlight to electricity



- **Wind** – Air movement to power

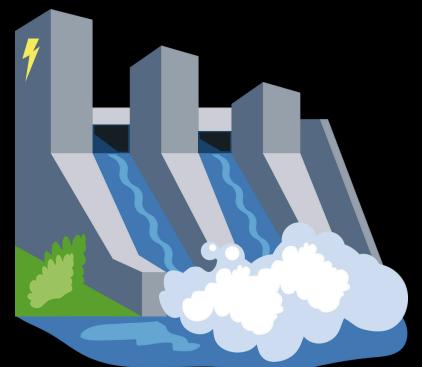
- **Hydro** – Flowing water to turbines

- **Geothermal** – Earth's heat

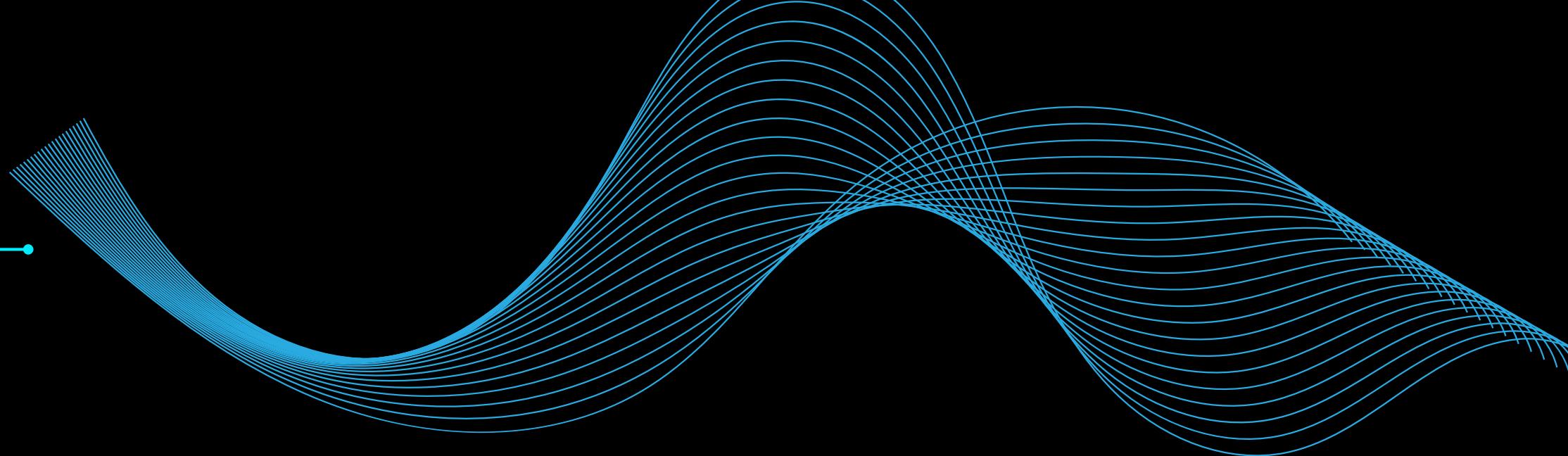
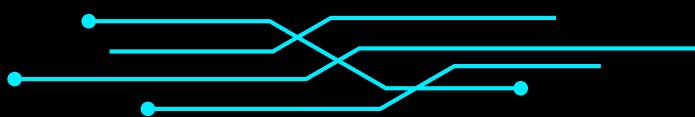
- **Biomass** – Organic material (plants, waste)

OUT OF THESE, SOLAR ENERGY IS THE MOST WIDELY AVAILABLE. IT IS PRESENT EVERYWHERE ON EARTH, EVEN IN REMOTE AREAS.

"RENEWABLE ENERGY IS NOT JUST AN OPTION ANYMORE, IT IS A NECESSITY FOR SURVIVAL"



# HOW WE WASTE ENERGY



In most thermal power plants (coal, gas, nuclear), energy conversion follows a long process:

1. Fuel is burned to produce heat
2. Heat boils water to create steam
3. Steam rotates turbines
4. Turbines drive generators to produce electricity

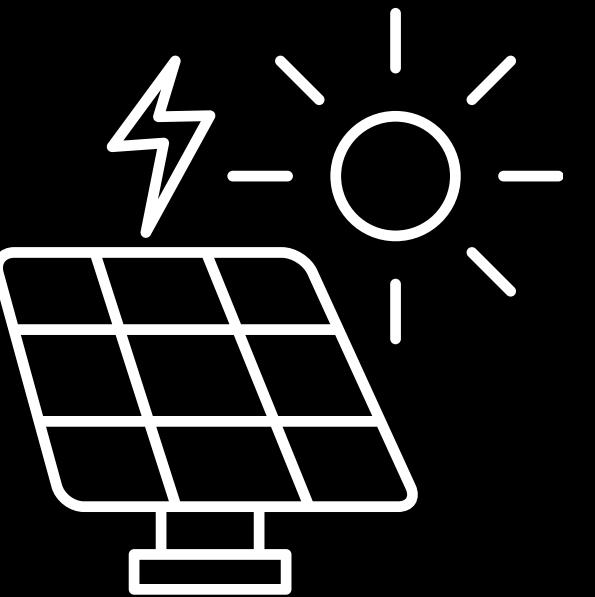


But at every step, a large part of the energy is lost as waste heat.

This makes thermal electricity generation inefficient, especially in a warming world.

**Solar PV skips all these steps by directly converting sunlight into electricity.**

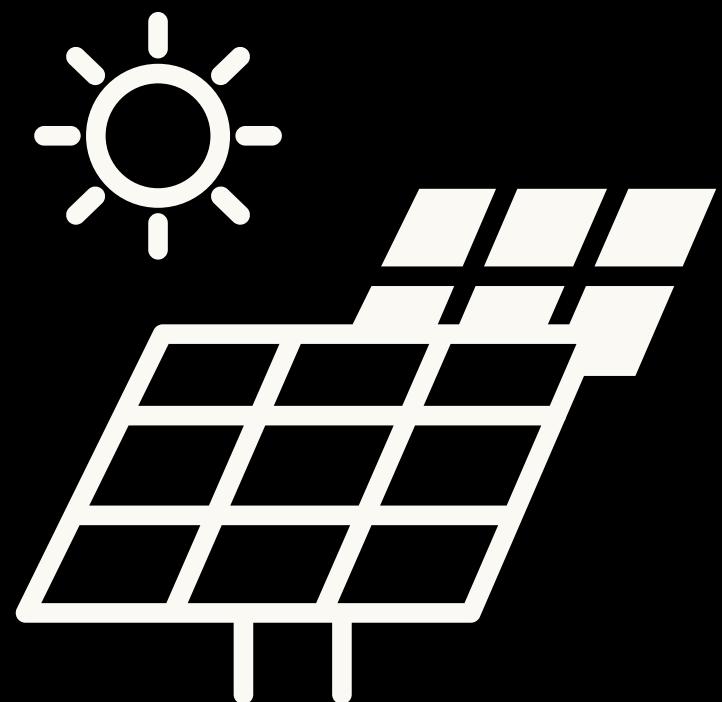
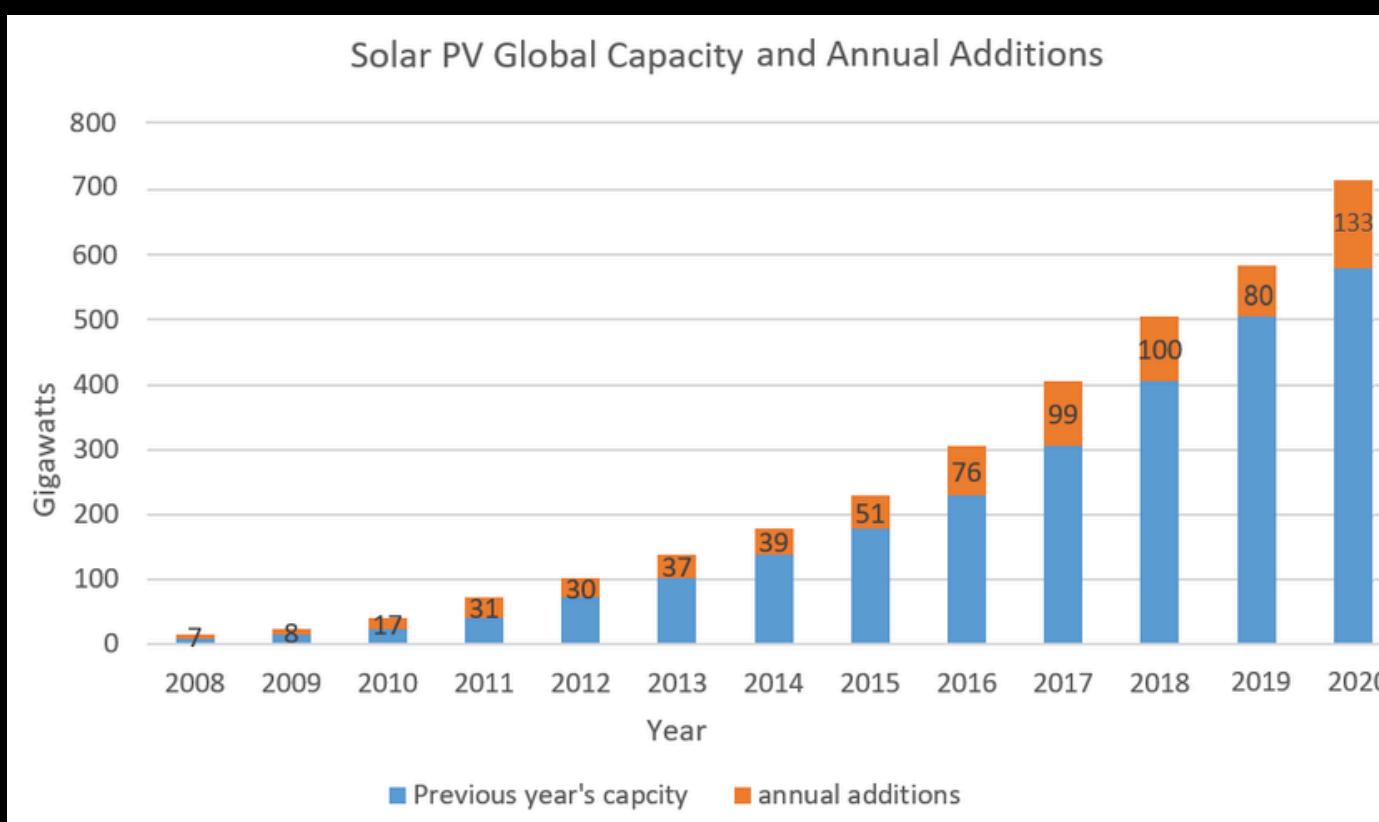
*More than 50% of the energy in fossil fuel plants is lost before it even reaches the consumer.*



# A GLOBAL SHIFT

Solar energy has grown faster than any other electricity source in recent years.

- Solar PV has grown over 40% per year since 2008
- Costs of PV modules have dropped by nearly 80% in the past decade
- Solar now competes with or even beats the cost of electricity from coal in many parts of the world
- Solar power has reached grid parity i.e. it costs the same or less than electricity from the grid



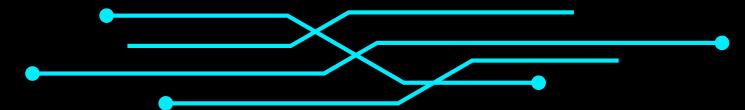
Traditional energy systems are centralized:

- Power is generated in large plants (coal, hydro, nuclear)
- Electricity travels long distances through grids
- High losses, high cost, and hard to maintain in remote areas

Solar is decentralized:

- Panels can be placed on rooftops, fields, or even small devices
- No need for long-distance transmission

# INDIA'S SOLAR OPPORTUNITY



India is one of the sun-richest countries in the world. Most parts of the country receive over 300 sunny days a year.

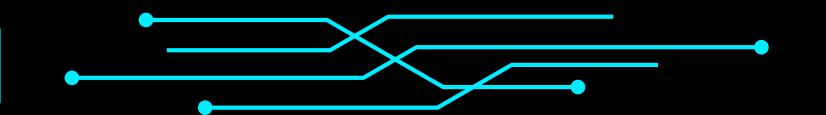
This makes India perfectly placed to lead the solar revolution.

- Government target: 500 GW of non-fossil energy by 2030, including major solar
- Massive solar parks: Bhadla (Rajasthan), Pavagada (Karnataka)
- Challenges include:
  1. Poor awareness in rural areas
  2. High upfront cost for homes
  3. Grid integration and policy delays

Solar is not just a climate solution, it's a development tool for India.



# REVIEW QUESTIONS



**Ques 1. What is the main reason fossil fuel-based power plants are inefficient?**

**Ques 2. What does a photovoltaic (PV) system do?**

**Ques 3. Explain why our current fossil fuel based electricity system is inefficient. How does solar photovoltaic (PV) technology offer a better alternative?**

**Ques 4. What makes solar energy an ideal source for India's energy future? Support your answer with at least two strong reasons discussed in slides.**

**Ques 5. Describe the key differences between centralized and decentralized energy systems. Why is decentralized solar energy important for future energy access?**



got any doubts  
regarding the  
course?



+91 8847603399



[samaydora.energiitb@gmail.com](mailto:samaydora.energiitb@gmail.com)

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+91 6391 275 528



[sushant.energyiitb@gmail.com](mailto:sushant.energyiitb@gmail.com)