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Q16

The Nobel Prize in Physics of 2014 was jointly awarded to Akasaki, Amano and Nakamura for the invention of Blue LEDs in 1990s. How has this invention impacted the everyday life of human beings ?

UPSC Civil Services Mains 2021 · GS III · 15 marks · Indian Economy

Indian Economy and issues relating to planning, mobilization of resources, growth, development and employment.

Core demand of the question

- The Nobel Prize in Physics of 2014 was jointly awarded to Akasaki, Amano and Nakamura for the invention of Blue LEDs in 1990s. How has this invention impacted the everyday life of human beings?
- Name Akasaki, Amano, and Nakamura. Stress **white LED** lighting and energy saving
- Keep the explanation within a 15-mark length

Revision summary

The 2014 Physics Nobel honoured Akasaki, Amano, and Nakamura for efficient blue LEDs in the 1990s.

Blue plus phosphor (or RGB mix) made **white LED** lighting practical.

White LEDs cut household and street electricity use and enabled solar lanterns.

Screens, traffic signals, and many medical lights rest on the same family of devices.

Quality, e-waste, and night-time blue light are the downsides of a genuine everyday revolution.

Introduction

The 2014 Nobel Prize in Physics went jointly to **Isamu Akasaki, Hiroshi Amano, and Shuji Nakamura** for efficient **blue light-emitting diodes** developed in the 1990s. Red and green LEDs already existed. Without blue, white light from semiconductors was incomplete. Blue LEDs made cheap, long-life white lamps possible, and that changed how the world lights rooms, screens, and streets.

Body

What they actually invented

- Akasaki and Amano at Nagoya, and Nakamura at Nichia, produced **bright gallium-nitride blue LEDs** after years when textbooks said it was too hard.
- Blue light plus a **yellow phosphor** (or red-green-blue mixing) yields **white LED light**.
- The prize was for the physics and materials breakthrough of the 1990s, not for every later bulb brand.

Everyday lighting and energy

- White LEDs use **far less electricity** than incandescent bulbs and typically less than compact fluorescents for the same lumen, with **longer life** and no warm-up.
- Households, shops, and offices cut bills and heat load. That is the largest daily impact.
- **Street lighting and public programmes** (including India's **UJALA**-era LED push) scaled the same physics into a national power-saving tool.
- Off-grid **solar lanterns** became useful because the lamp finally sipped watts that a small panel could feed. That changed nights in unelectrified and unreliable-grid homes.

Screens, signals, and work

- **Mobile phones, laptops, and TVs** use LED backlights or OLED cousins of the same semiconductor family. Daily reading, navigation, and work sit on that light.
- **Traffic signals, railway aspects, and automotive lamps** last longer and fail less, which is a safety as well as a power fact.
- **Flashlights, bicycle lamps, and indoor plants' grow lights** became small and cheap.

Health, environment, and culture

- Lower power for lighting cuts **coal and oil burn** at the margin, which is a climate and urban-air gain when grids are fossil-heavy.
- LEDs avoided some **mercury** that fluorescent tubes carried, though they create an **e-waste** stream that policy must collect.
- Medical **phototherapy** and dental curing lights use blue and related LEDs.
- **Cultural life:** cheaper stage and festival lighting, and a 24-hour visual culture of screens.

Limits of the miracle

- Poor-quality LEDs flicker or render colour badly. **Blue-rich night light** can disturb sleep if used thoughtlessly.
- The Nobel was not a prize for every Chinese bulb in a grey market. Quality standards decide whether the poor actually save.

Flow diagram

Blue LED 1990s -> White LED with phosphor
White LED with phosphor -> Low-watt home and street light
White LED with phosphor -> Screens signals lanterns
Low-watt home and street light -> Daily energy saving
Screens signals lanterns -> Daily energy saving

Conclusion

Akasaki, Amano, and Nakamura's blue LED completed white semiconductor lighting. Everyday life changed through cheaper, longer-lasting lamps, solar lanterns, screens, and signals. The human impact is energy saved in the room and light where a grid never reached.

Facts & figures

2014 Nobel Physics

Jointly awarded to Isamu Akasaki, Hiroshi Amano, and Shuji Nakamura for blue LEDs.

Gallium nitride

Semiconductor material that made bright blue LEDs possible.

White LED

Typically a blue LED plus yellow phosphor; the everyday lighting product.

UJALA

Indian programme that bulk-procured LED lamps and cut household lighting load.

Solar lantern

Off-grid lamp that became practical because LEDs draw little power from a small panel and battery.

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