

Green Technologies - Why the World Needs It For a Sustainable Future

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Green Technologies Latest News

- Amid rising energy demands and climate concerns, experts are calling for a shift toward more efficient and scalable green technologies beyond conventional silicon photovoltaics and green hydrogen.

Introduction

- The world is racing to meet its climate commitments amid the growing urgency of energy self-sufficiency, carbon emission reduction, and geopolitical uncertainty.
- While green technologies like **silicon photovoltaics** and **green hydrogen** have catalysed a global energy transition, they are no longer sufficient in their current forms.
- The future demands not just more renewable deployment, but smarter, more **efficient, diverse, and scalable green technologies** that better serve a resource-constrained world.

Limitations of Current Green Technologies

- **Silicon Photovoltaics: Dominant Yet Inefficient**

- Invented in 1954 by Bell Labs, **silicon photovoltaics (PV)** have become the backbone of renewable energy worldwide. However, their limitations are becoming apparent:
 - Typical **efficiencies range from 15% to 21%**, with lower actual field performance.
 - **Land-use intensity** is high due to low energy conversion rates; a doubling of efficiency could halve the land required.
 - Over 80% of silicon solar panels come from China, raising strategic and supply chain concerns.
 - India, with ~6 GW of production capacity, is expanding its silicon PV output, but must also prepare to leapfrog toward **next-generation solar technologies** like gallium arsenide thin-film cells, which have demonstrated up to **47% efficiency** in labs.

- **The “Green” in Green Hydrogen is Relative**

- **Green hydrogen**, produced by electrolysis using renewable energy, is a promising clean fuel. However, it suffers from key drawbacks:
 - **Energy inefficiency:** Electrolysis consumes more energy than the energy value of the hydrogen it produces.
 - **Storage and transportation challenges** due to hydrogen's low density and leakage issues.
 - **Conversion losses** in creating and later separating hydrogen from green ammonia or methanol.
- Therefore, while green hydrogen is technically clean, its **overall lifecycle efficiency is poor**, especially when powered by low-efficiency PV systems.

Rethinking Fuel Production and CO₂ Utilisation

- To overcome these hurdles, researchers are exploring **Artificial Photosynthesis (APS)**, mimicking plant-based CO₂ recycling to produce fuels like **green methanol and green ammonia** directly from sunlight, water, and atmospheric gases.
- While APS is currently confined to lab research, it represents a **breakthrough pathway** for truly sustainable fuel production.
- Meanwhile, **Europe is pushing ahead with Renewable Fuels of Non-Biological Origin (RFNBOs)**, which avoid biomass and use pure renewable inputs.
- India, too, must pivot toward such futuristic innovations to reduce its **85% dependence on imported energy**, which includes oil, coal, and natural gas.

Land Scarcity and the Efficiency Imperative

- Land scarcity is becoming a significant constraint:
 - Urbanisation and biodiversity conservation limit the availability of large tracts for solar installations.
 - With rising **CO₂ concentrations** (from 350 ppm in 1990 to 425 ppm in 2025), current green technologies are **not scaling fast enough** to reverse climate trends.

- Thus, doubling down on **high-efficiency technologies** becomes essential, not just to generate more power per square metre, but also to enable complementary decarbonisation solutions like green hydrogen and RFNBOs to succeed.

Policy and Investment Implications

- Governments must now shift from deployment to **diversified innovation**. India's energy roadmap should include:
 - **Increased R&D spending** on next-gen energy systems
 - **Public-private partnerships** to accelerate commercialisation
 - Strategic support for **deep-tech innovations** like APS and RFNBO
 - **Redesign of subsidies** and incentives to favour higher efficiency, land-saving, and lifecycle-optimised technologies
- As **geopolitical instability** threatens global supply chains, energy independence through innovation is no longer optional; it is urgent and essential.

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