BRUGES 9-12 SEPTEMBER ESSERC 2024

GreEnergy
Power from optical antennas

Second GreEnergy workshop - Wideband optical antennae for use in energy harvesting applications

Setting a new paradigm for solar energy harvesting

9 September 2024

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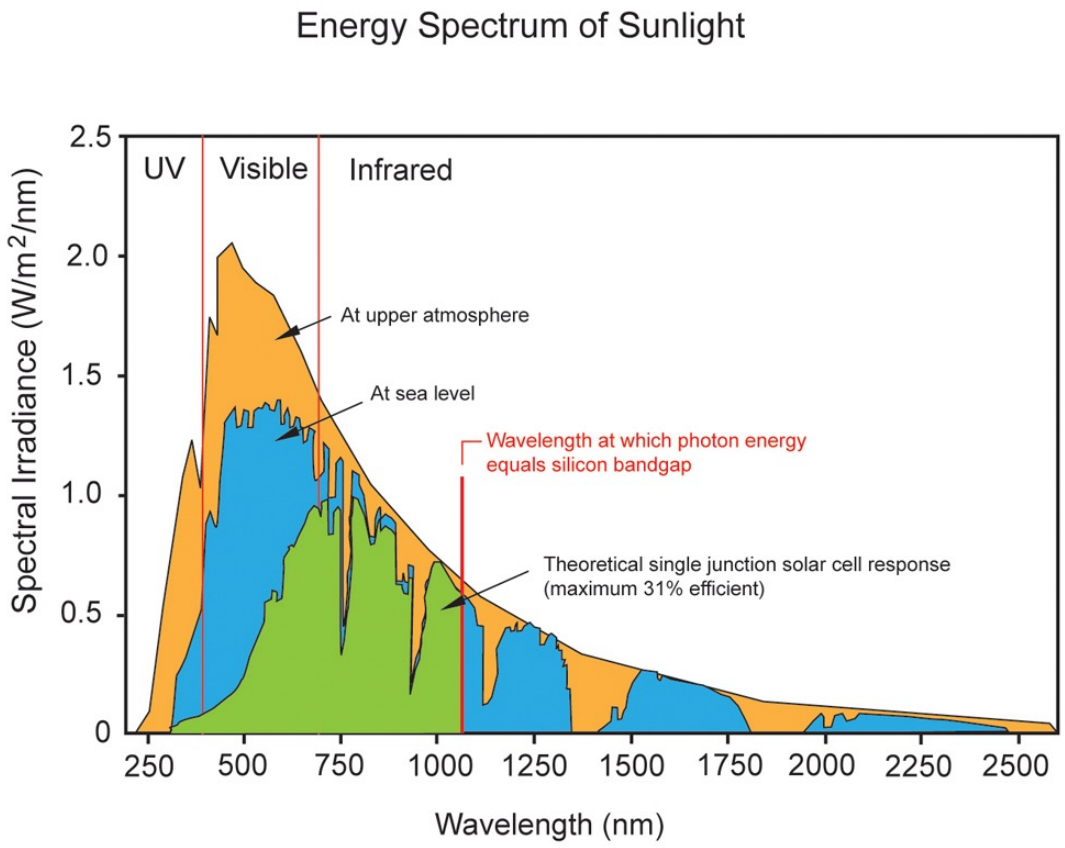
IEEE SSCS Electron Devices Society

The sun is the world's most powerful energy resource

- **The sun is the world's most powerful** and abundant **energy resource, and offers a nearly unlimited supply of energy to our planet.**
- Current **solar photovoltaics produce however only about 4% of the world's electricity**, due to their low efficiency and relatively high costs.
- **GreEnergy's ambition** is to define a new **paradigm in the field of solar energy harvesting** by prototyping a self-powering system based on optical nano-antennas that can harvest solar energy, rectify the AC signal and use it to charge a micro-supercapacitor.

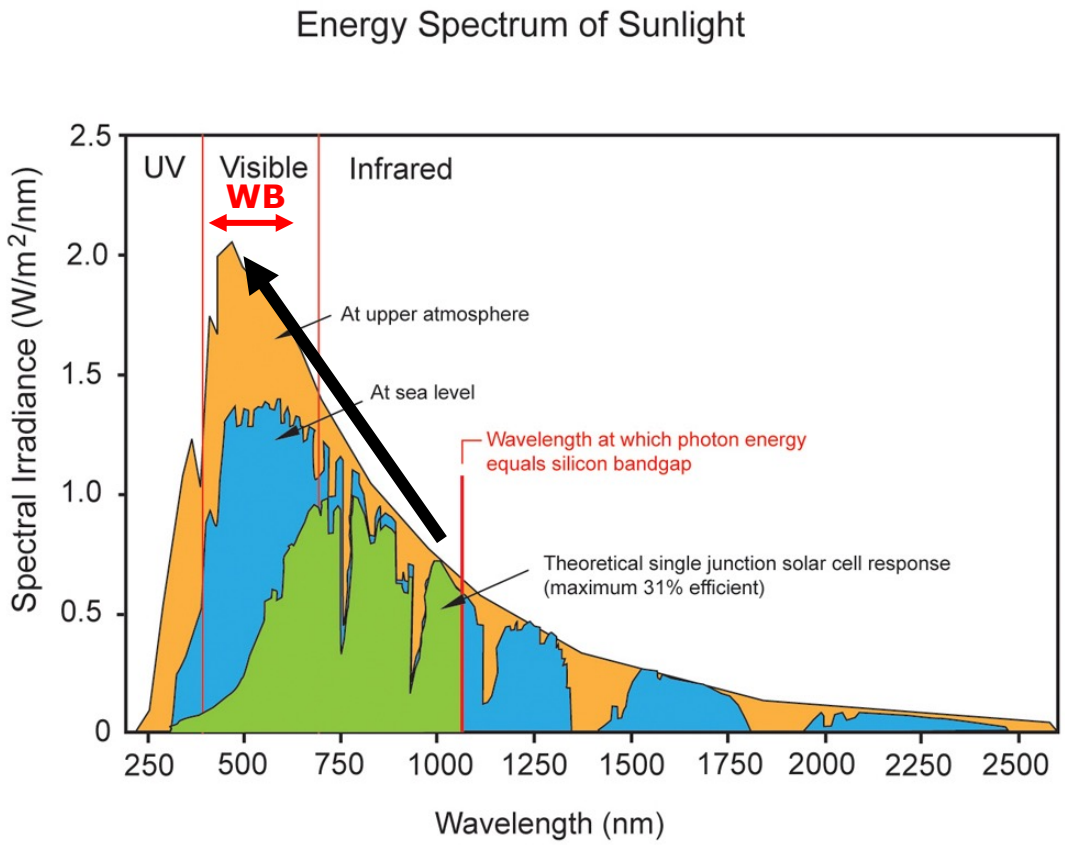
PV efficiency limit

- Traditional single-junction cells with an optimal band gap for the solar spectrum have a maximum theoretical efficiency of **33.16%**, the Shockley–Queisser limit
- The efficiency of commercial solar panels typically ranges from **15% to 20%**, and some can reach up to 25%



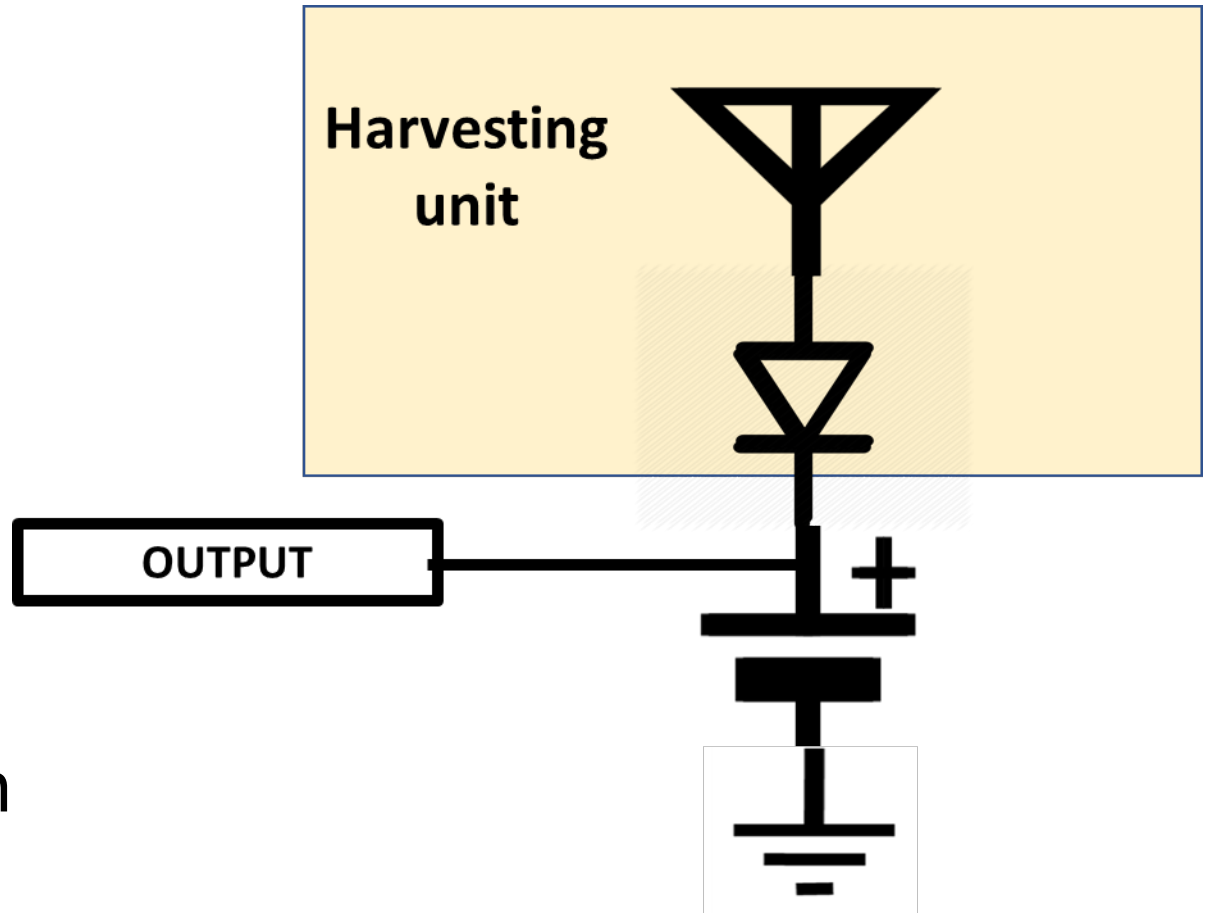
GreEnergy challenges

- Harvesting the visible region rather than the IR region (higher energy)
- Using Wide Band range
- Increasing the harvesting efficiency to 40-60%.
- Systems approach – a single chip with the energy harvesting unit, electronic circuitry and energy storage.

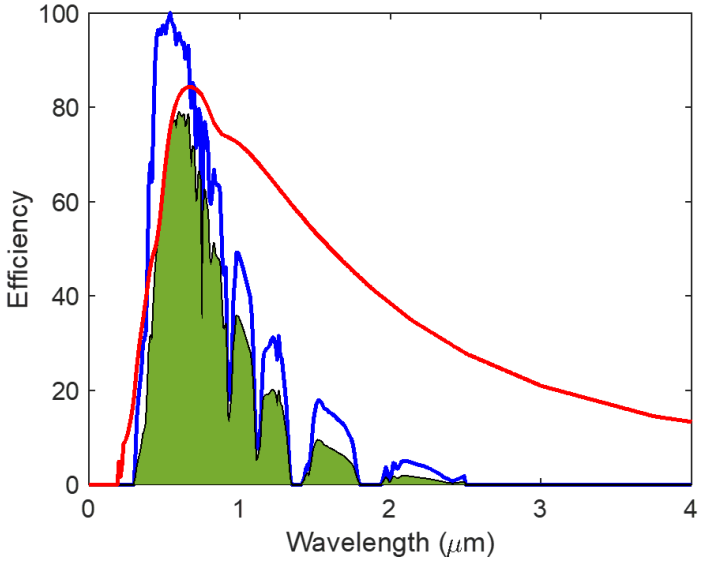


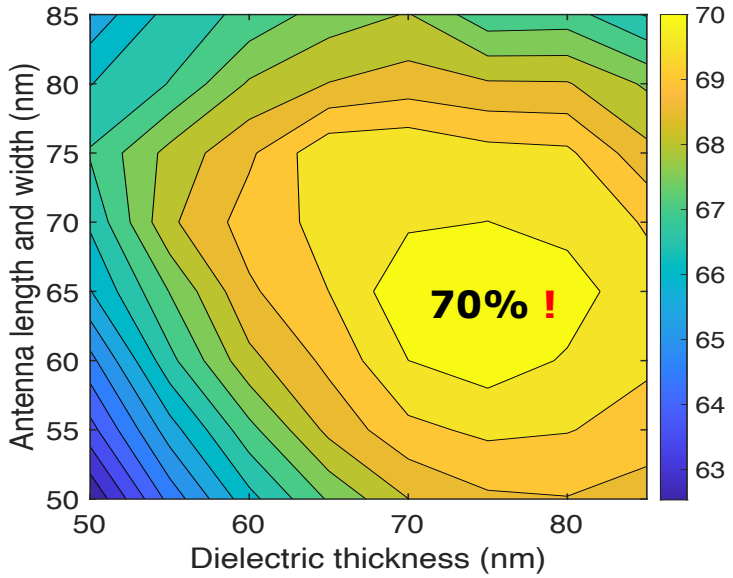
GreEnergy system and methodology

- Using nano antenna for harvesting the visible region. Theoretical efficiency over 90%.
- Using a rectifier.
- Electronic circuitry and energy storage.
- Applying system methodology: modelling, design, manufacturing, measurements, risk assessment and mitigation plan

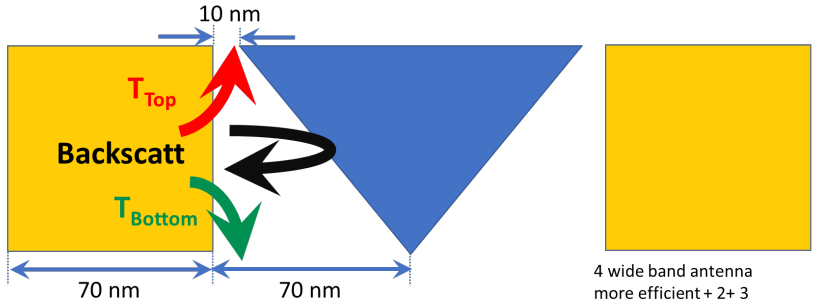


Some preliminary modelling results





30% is just dissipated or reflected



4 wide band antenna
more efficient + 2+ 3

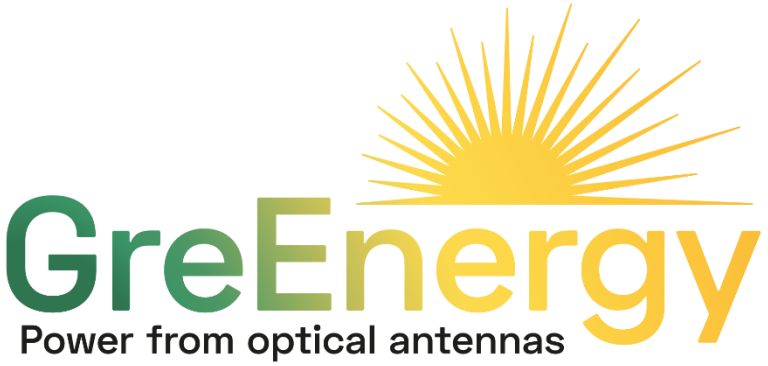
Trajectory	Efficiency
T_{top}	6% (previous slide 8%)
Backscattering	25% (previous 50%)
T_{Bottom}	69% - 11:1 ratio (41% - 5:1)

KEY POINT

MEAN FREE PATH LENGTH

$\gtrsim$ 150÷200 nm

Thank you!



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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006963 (GreEnergy).