Sustainable Places 2022
Low-TRL Renewable Energy Technologies workshop

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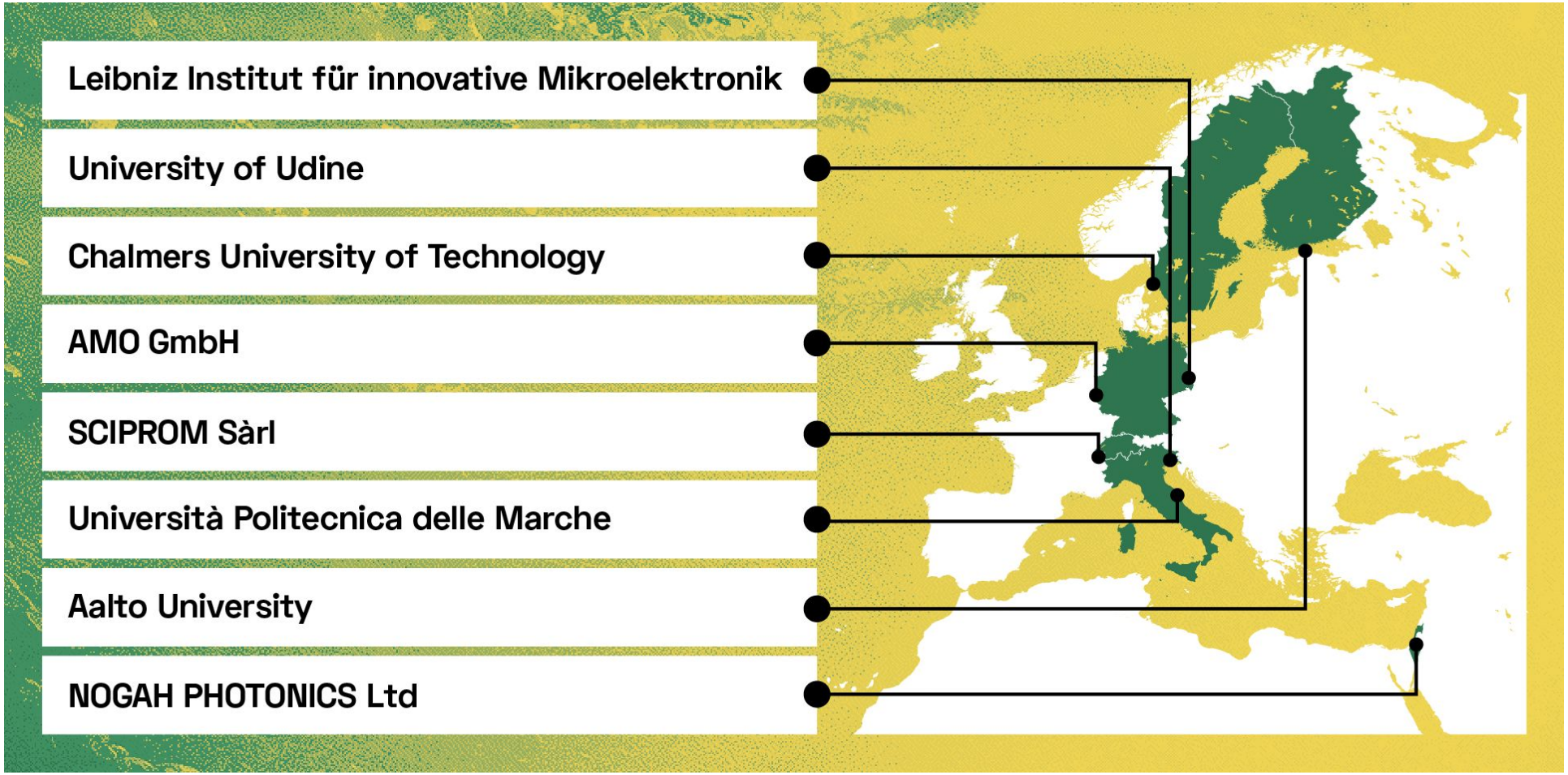
Wideband optical antennas for use in energy harvesting applications

GreEnergy

SUSTAINABLE PLACES

GreEnergy - Factsheet



Horizon 2020
Call:
H2020-LC-SC3-2018-2019-2020
(BUILDING A LOW-CARBON, CLIMATE RESILIENT FUTURE: SECURE, CLEAN AND EFFICIENT ENERGY)

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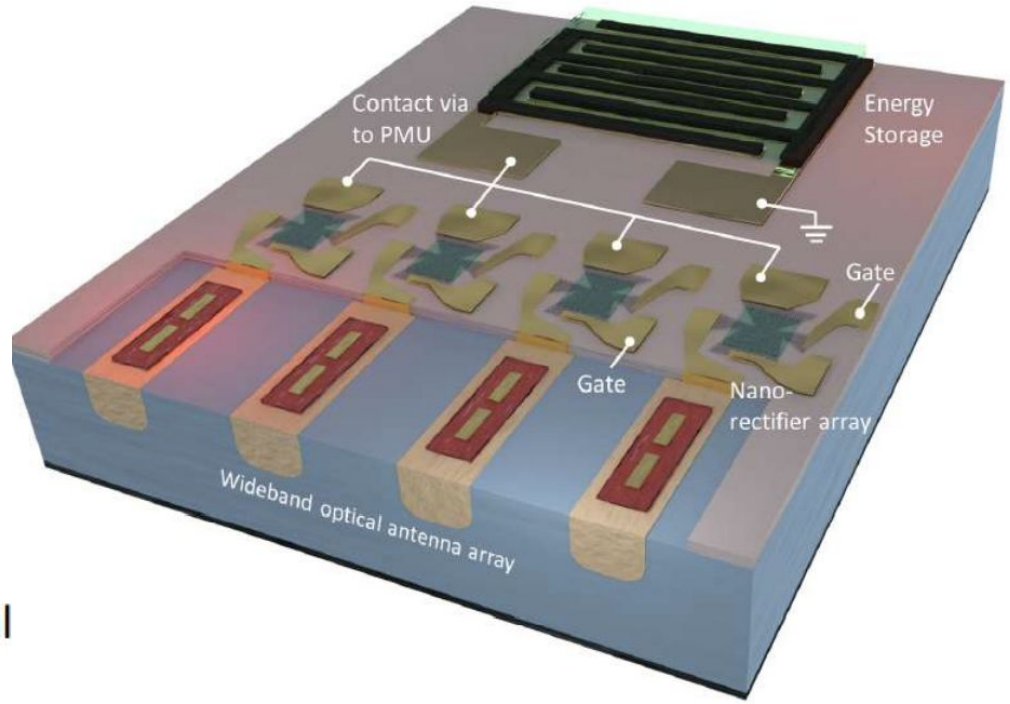
Objectives of GreEnergy

- Development of optical antenna with 20-40% energy efficiency using wide bandwidth nano-antennas
- Development of nano-rectifier and energy storage components
- Develop process for on-chip integration of antenna/rectifier with power management unit and energy storage device
- Develop prototype of integrated system, which demonstrates successful charging of the supercapacitor by the antenna/rectifier system

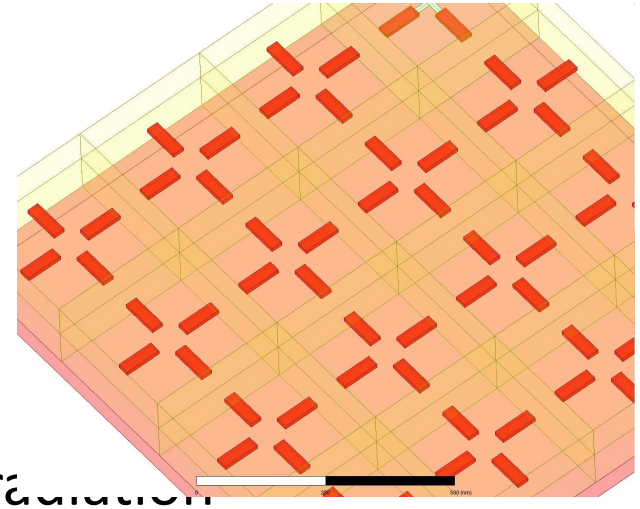


Concepts and approaches in GreEnergy

Sun-light harvesting: receiving antennas

Any antenna to be designed for solar harvesting faces challenges:

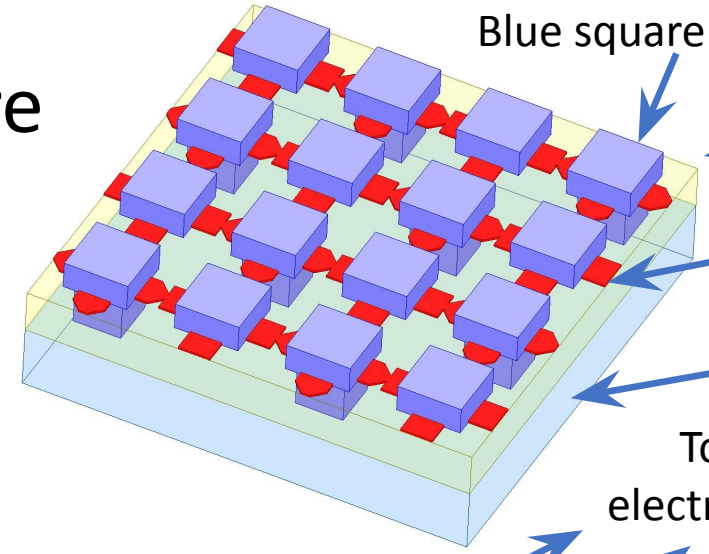
1. large **bandwidth**, from roughly 300 nm to 3000 nm
2. **planar** profile, to reduce size/weight and cost of solar panel
3. insensitiveness to **polarization and angle** of arrival of the em radiation
4. radiation diagram that spans a **half space** only

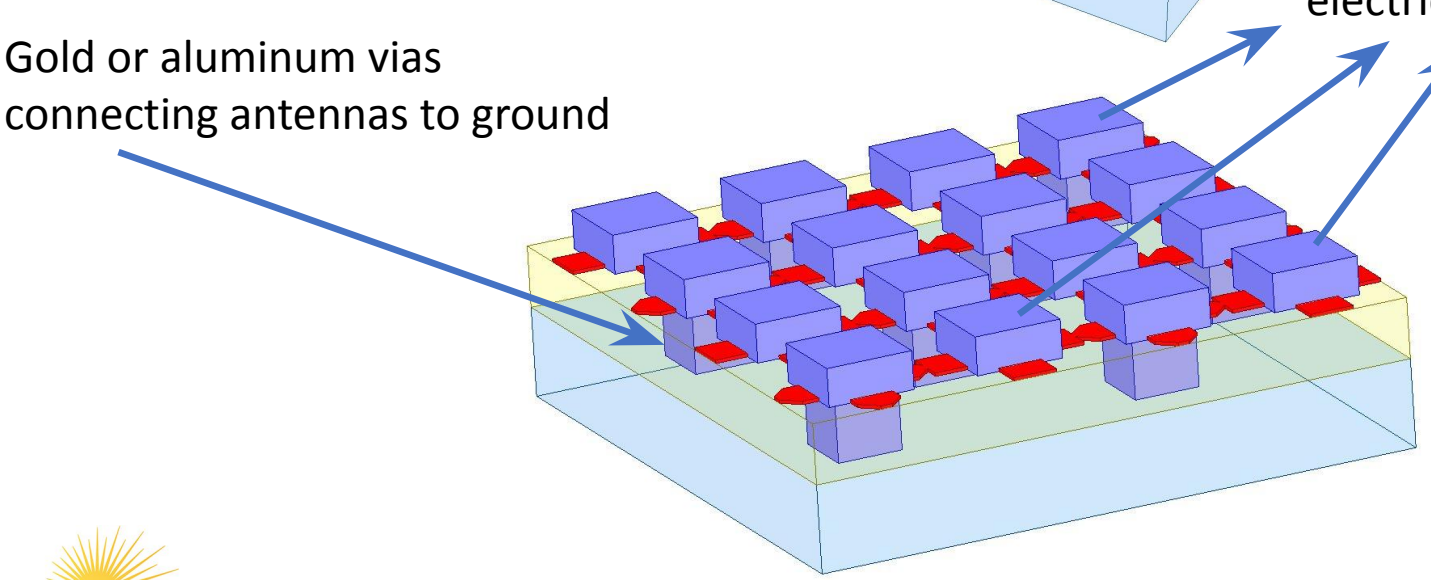


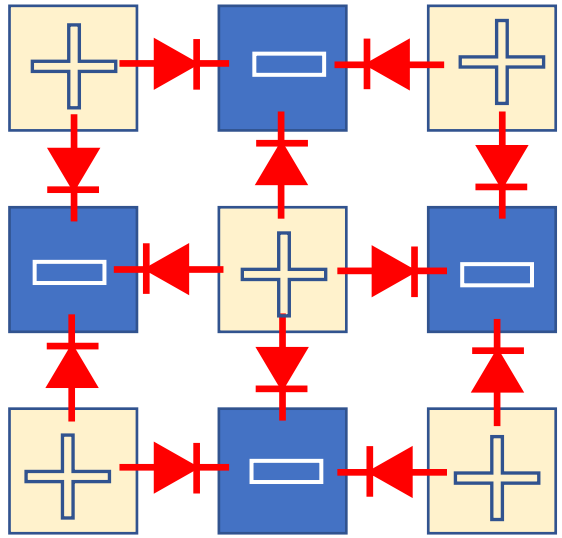
Concepts and approaches in GreEnergy

Proposed architecture

Double polarization







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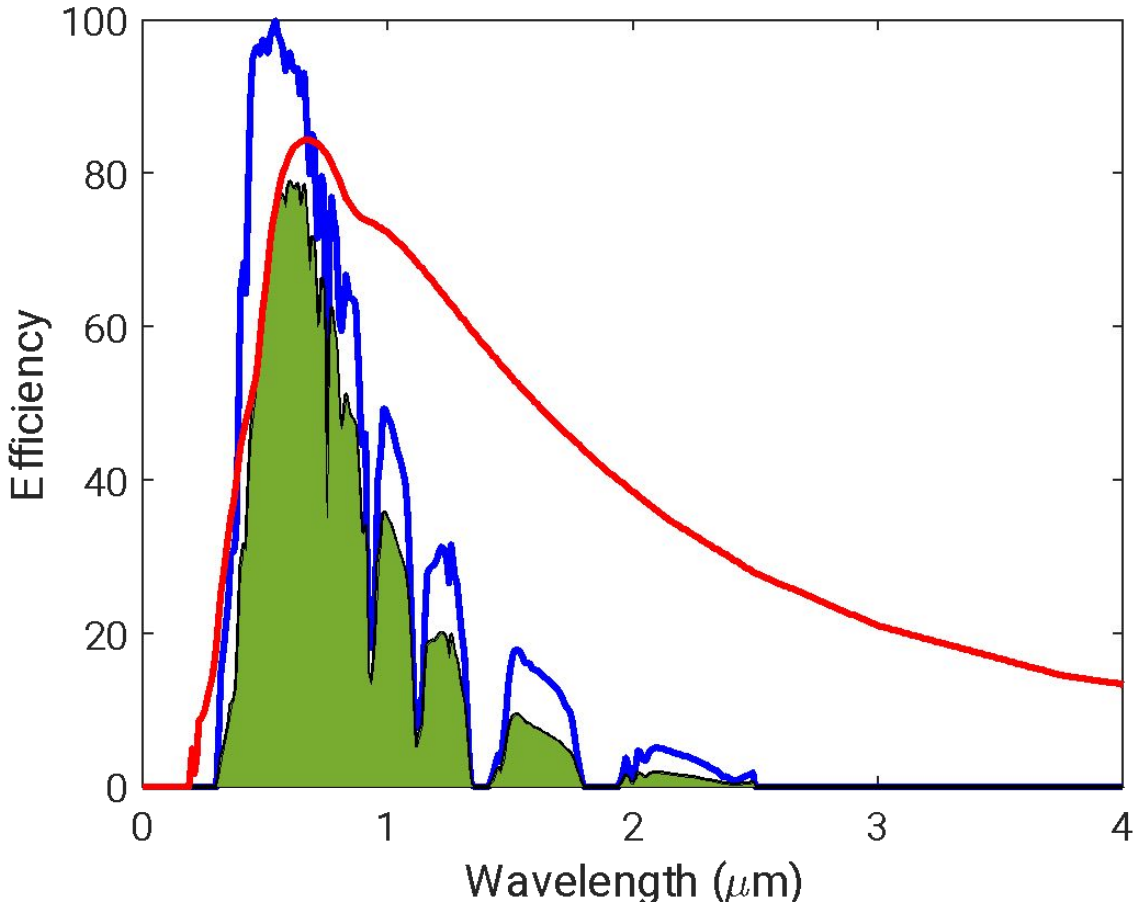
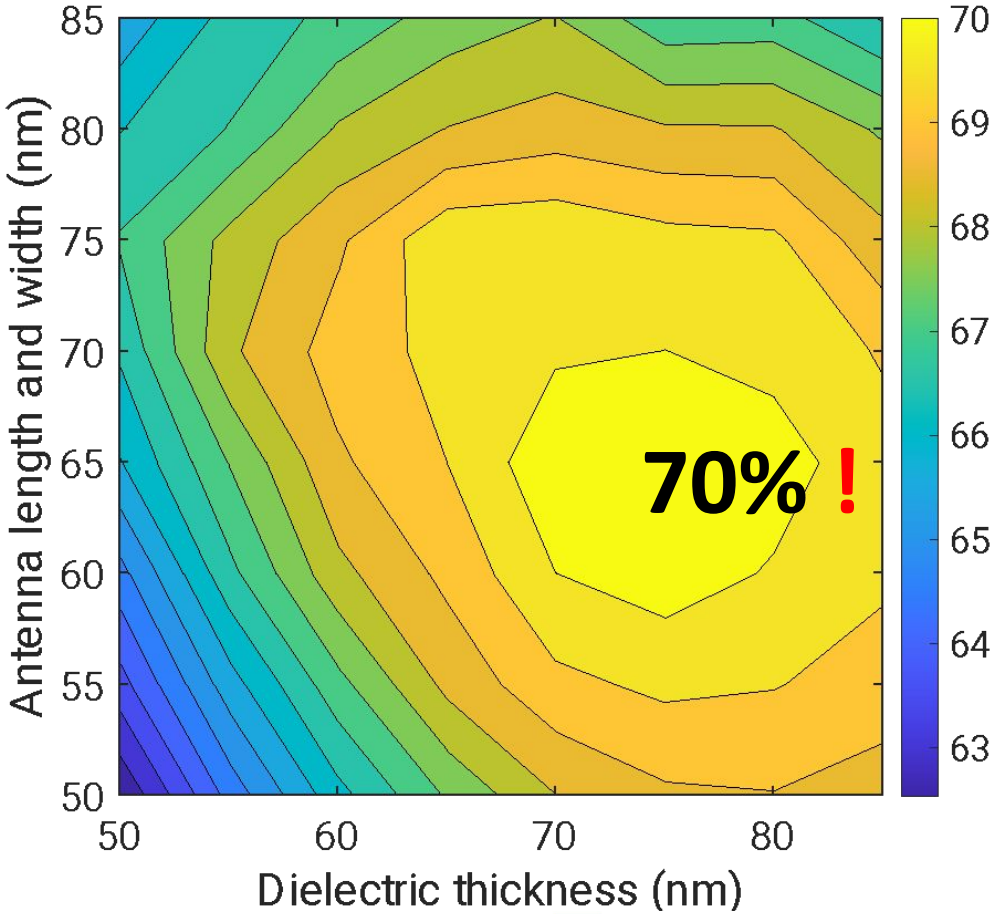
Antenna efficiency



RECEIVING efficiency



30% is just dissipated or reflected

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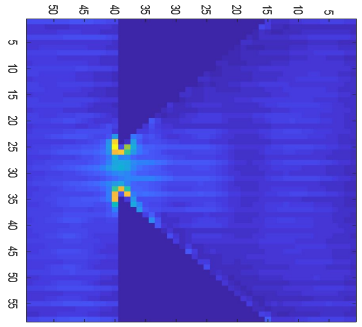
Geometric graphene diode

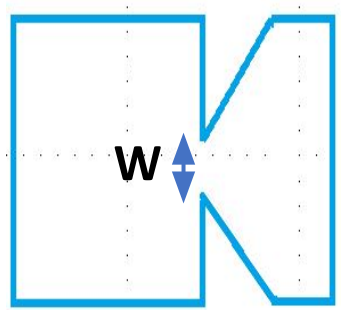
Increasing diode size, keeping the neck size fixed:

a. the I-V asymmetry decreases

b. the amount of current increases (diode impedance decreases)

c. the reverse-bias current increases





Effect of the **diode size**

Progress achieved in GreEnergy

Current status

- ✔ Receiving efficiency as high 70% has been simulated by periodic metal/dielectric/graphene structure
- ✔ Geometric diode solutions are evaluated with sensitivity to the main parameters

Latest developments

- ✔ Feedback from fabrication is in progress: useful information are being provided for the development of the project

Main challenges and next steps

Challenges

- Low current-voltage asymmetry and high reverse-current level
- Metal-to-graphene and diode resistances as high as KΩ·µm
- Power limitation by the finite solar spatial coherence
- Fabrication issues due to challenging and new structures

Next steps

Using experimental feedback to refine 1) antenna-diode matching and 2) quantum models

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