EINDHOVEN UNIVERSITY OF TECHNOLOGY

Plantenna: Creating an Internet of Plants for a Sustainable Future

Some preliminary results

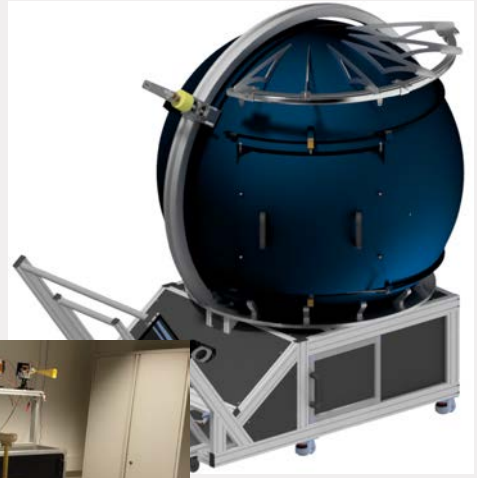
Sander Bronckers

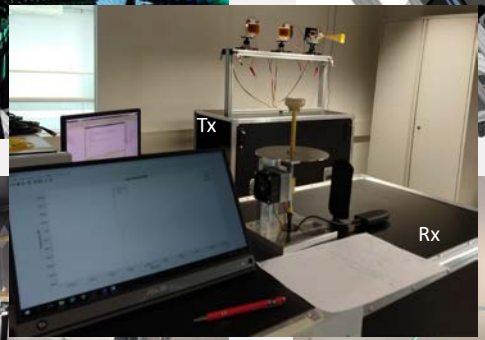
Electrical Engineering, Electromagnetics group

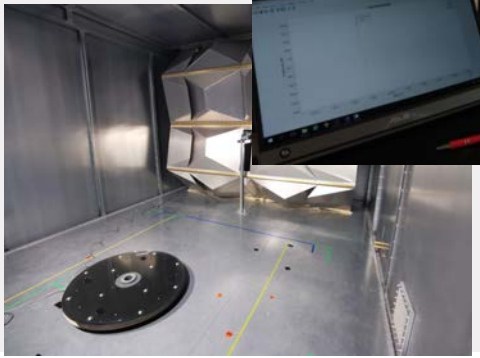
Our Road the Next 25 Minutes

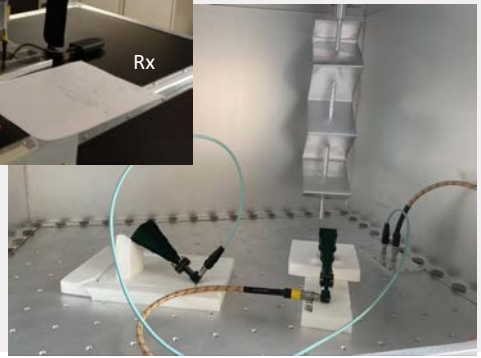
- About me
- Plantenna: the movie
- The problem
- Plantenna vision
- Connection to Wireless Engineering
- Questions and Discussion

About me



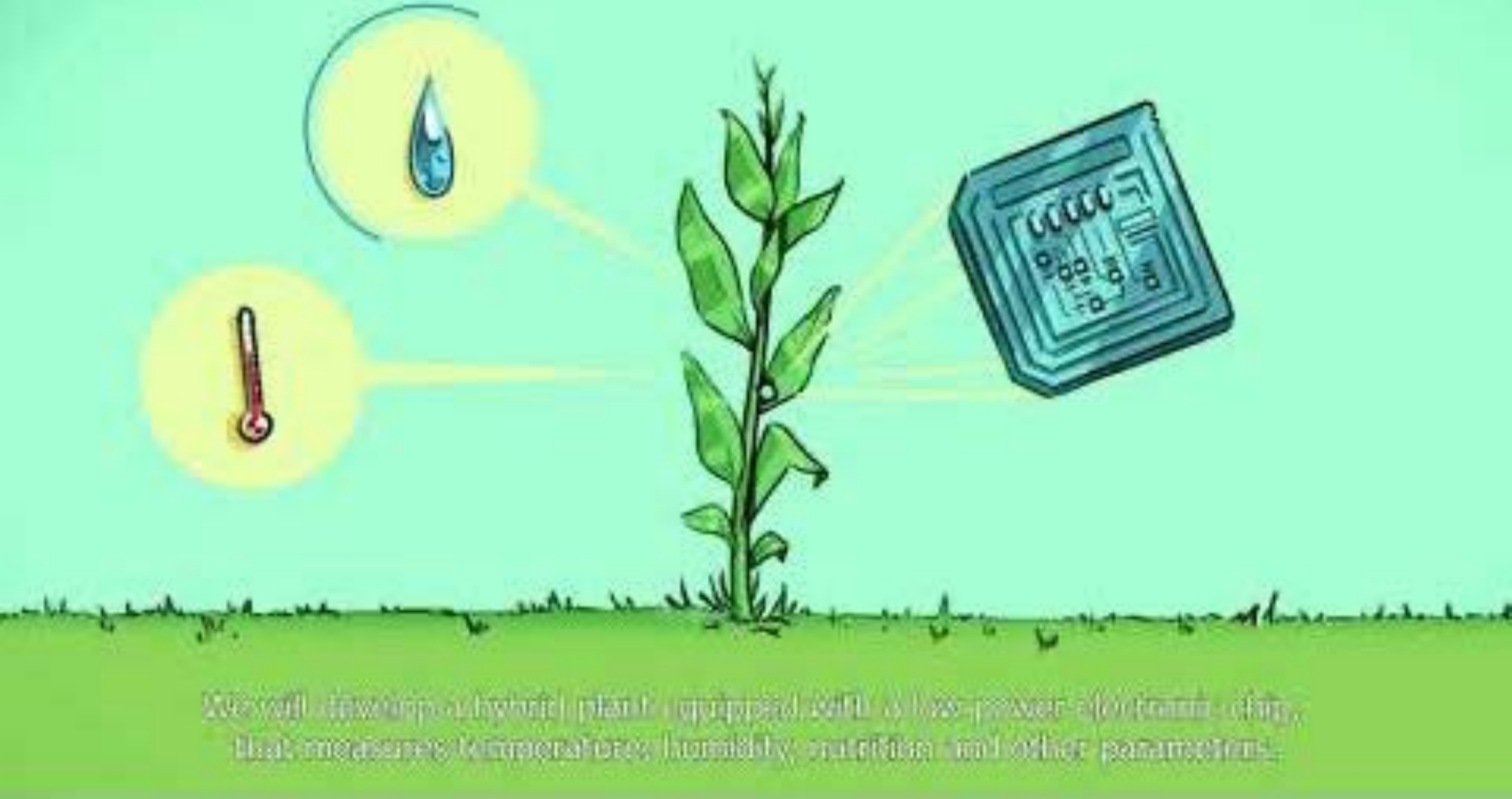


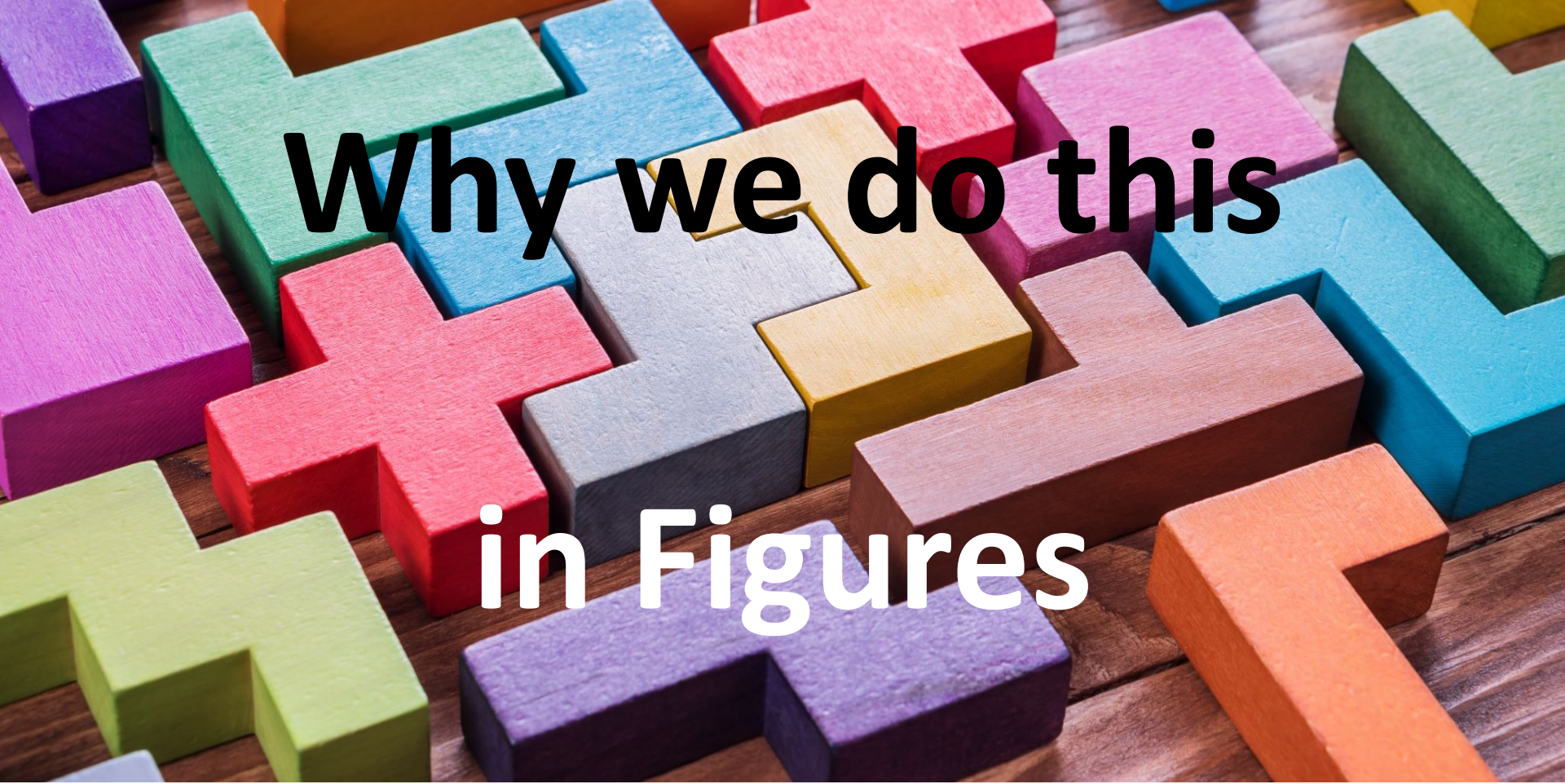




Plantenna

https://www.youtube.com/watch?v=GBTeQOneymc

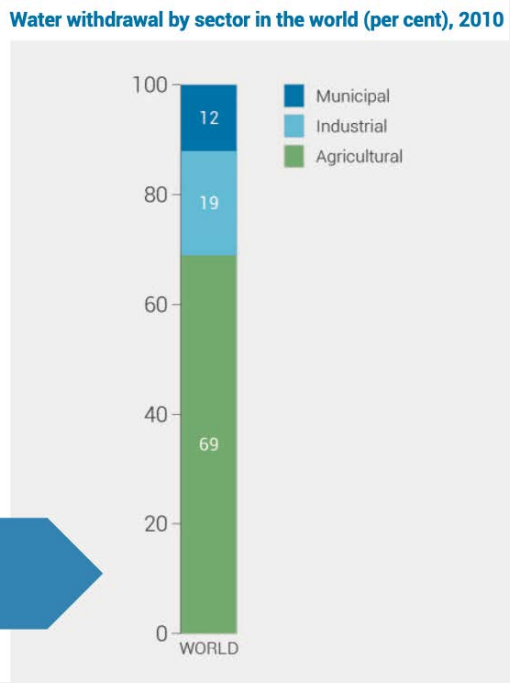




Why we do this

in Figures

Water Usage...

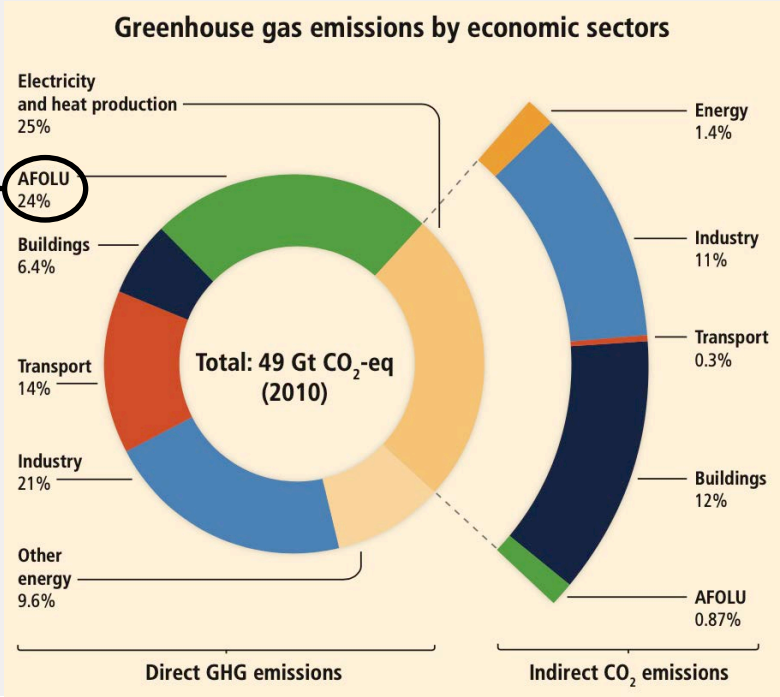


Agriculture accounts for 69 per cent of annual water withdrawals.

UN-Water: SDG 6 Synthesis Report 2018 on Water and Sanitation

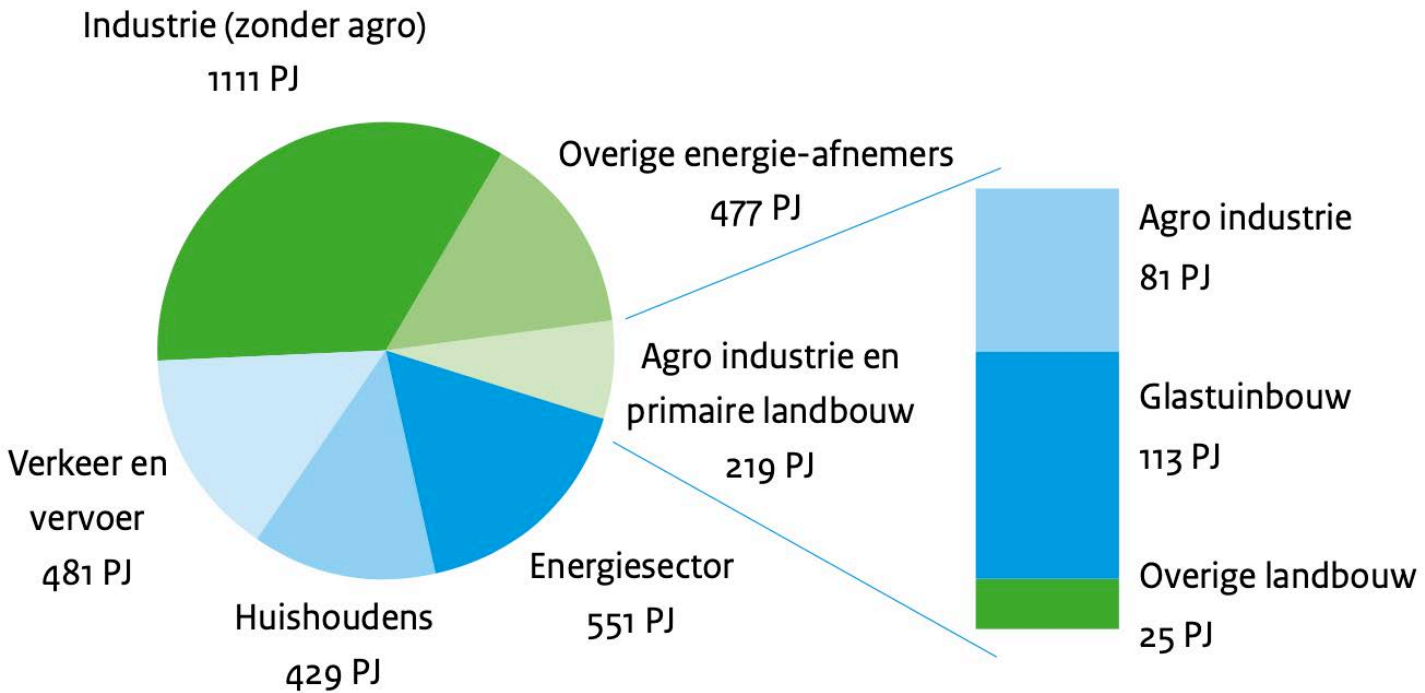
Greenhouse Gas Emissions...

AFOLU: Agriculture, Forestry and Other Land Use



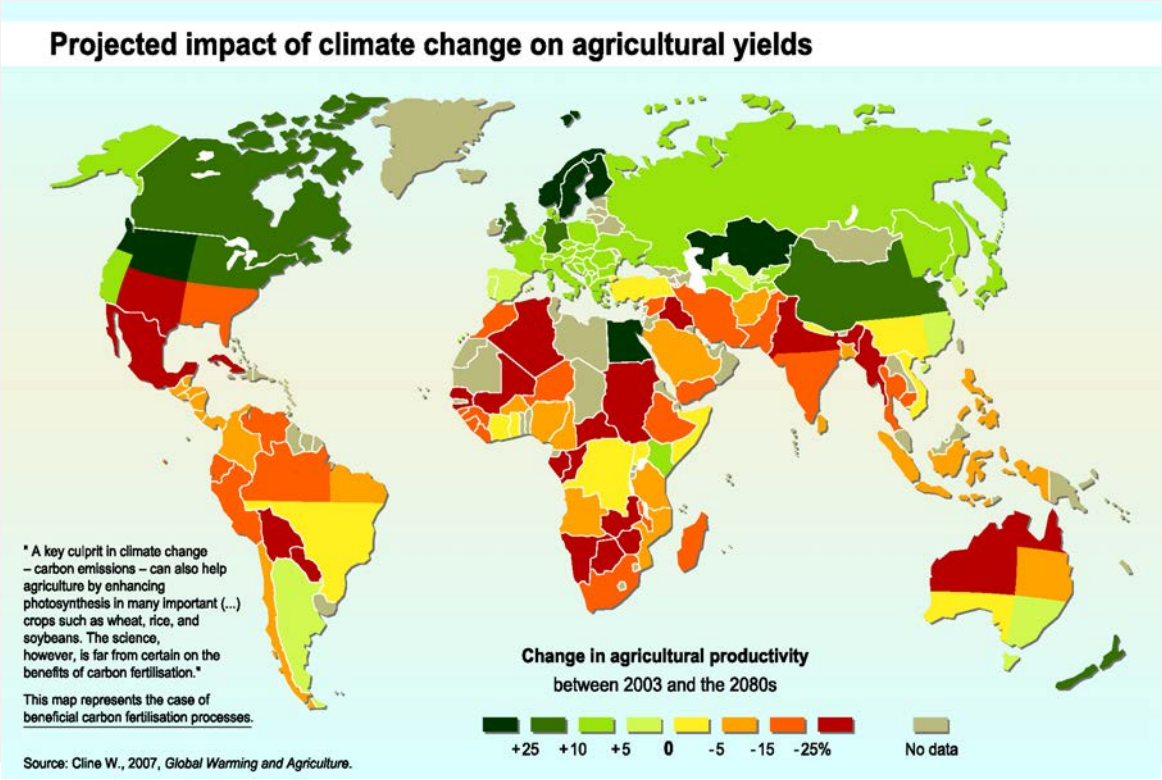
IPCC, 2014: Climate Change 2014: Synthesis Report.

Energy Usage...

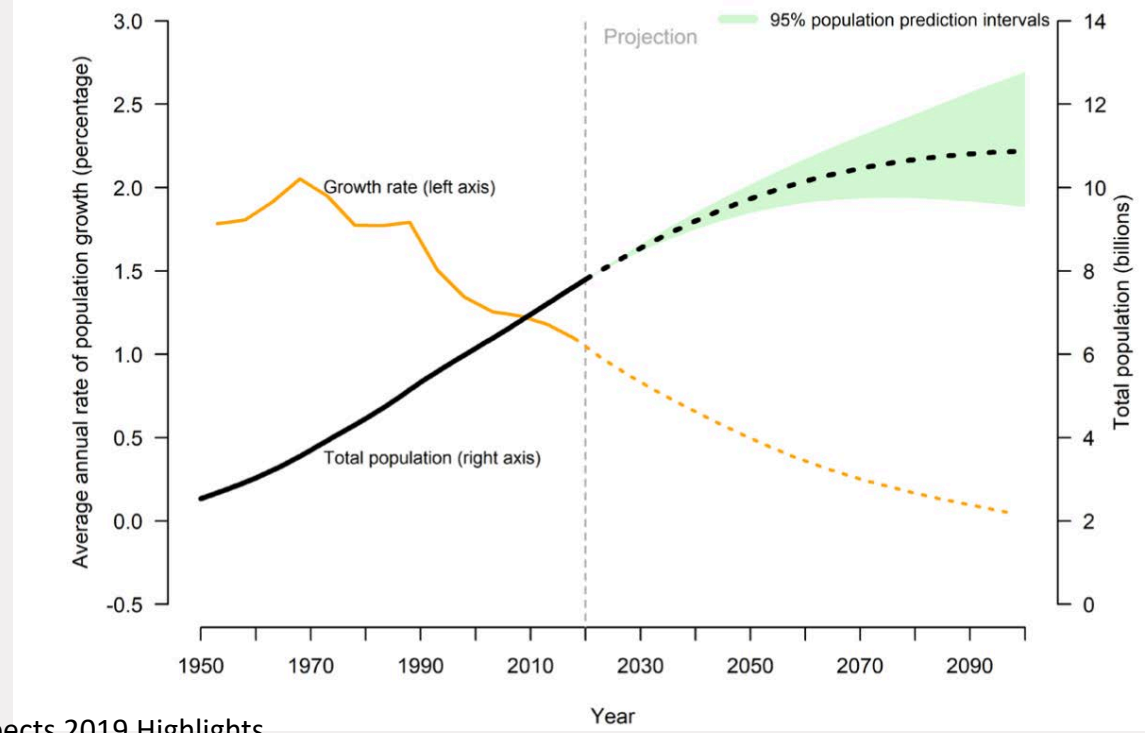


RVO: Energie en klimaat in de agrosectoren

Climate Change...



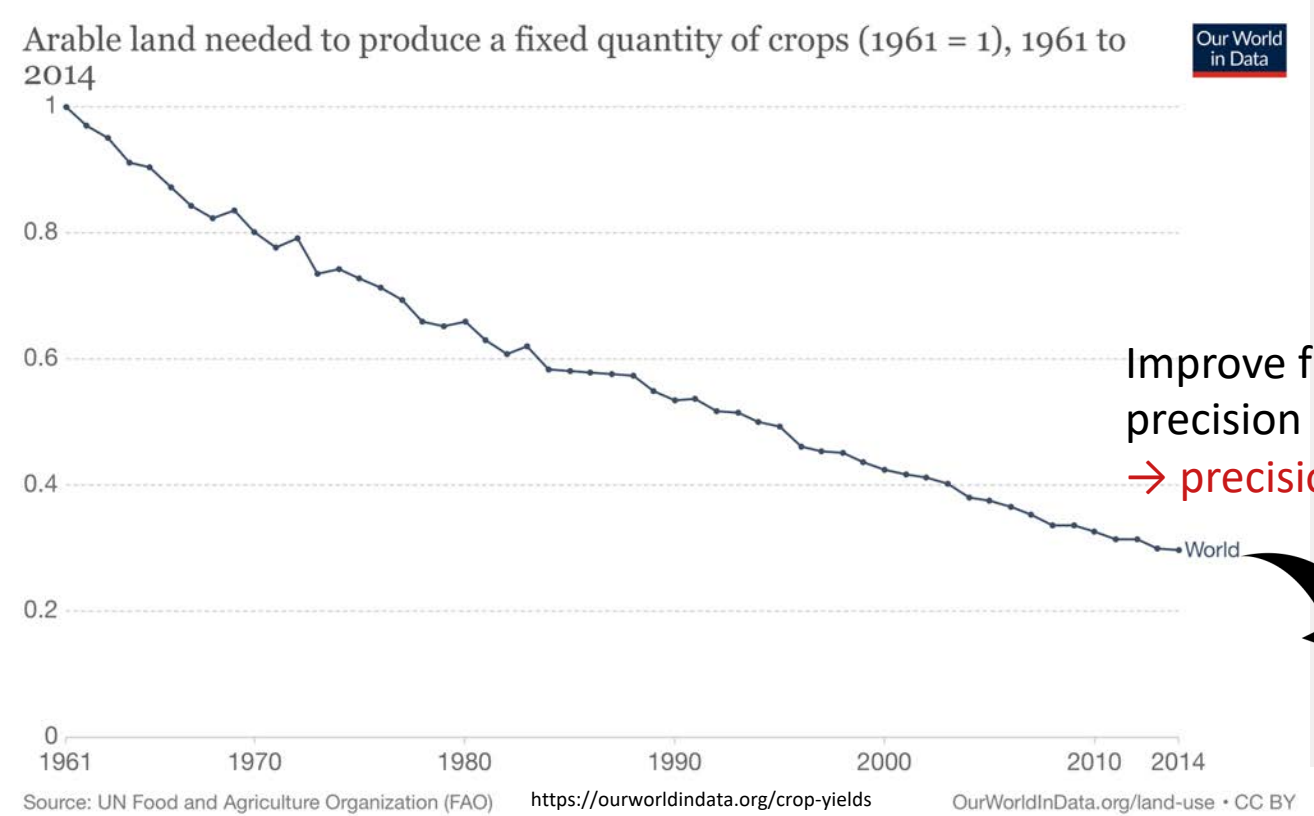
With a Growing Population...



UN: World Population Prospects 2019 Highlights

Solution?

Solution: increase the yield!

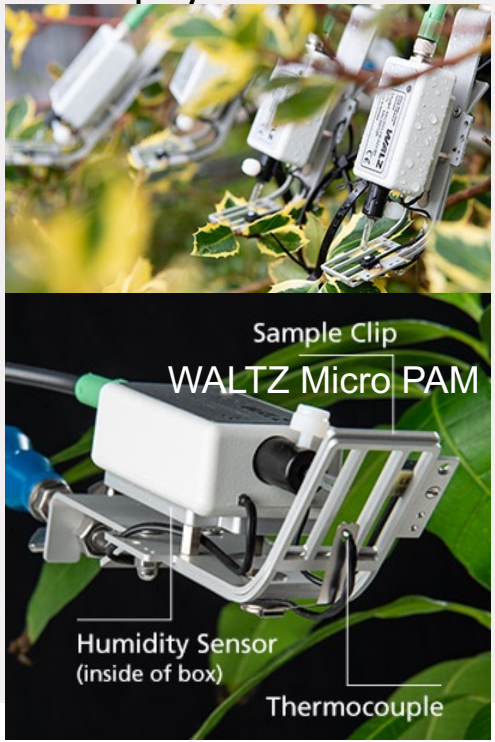


https://ourworldindata.org/crop-yields

Improve further using precision agriculture
→ precision info!

Current sensor solutions

Chlorophyll fluorometers



Moving systems

Handhelds

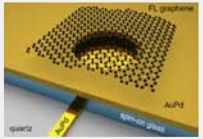
...Remember?

Plantenna Vision: Go Small, Go Cheap... Go Wireless!

Many different sides to Plantenna

TU Delft Delft University of Technology | TU/e Eindhoven University of Technology | University of Twente. | Wageningen University & Research

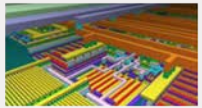
4TU.



Pressure sensor TUD

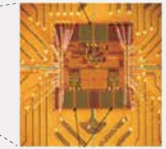
Crop quality sensor WUR

Weather station TUD



3D nm-scale chip-design UT

Wireless autonomous temperature sensor TU/e



Antennas & networks TU/e

WP1
Sensors and readout circuits

WP2
Energy efficient electronics and system architectures

WP3
Cyber plant

WP4
Communicating networks of plants

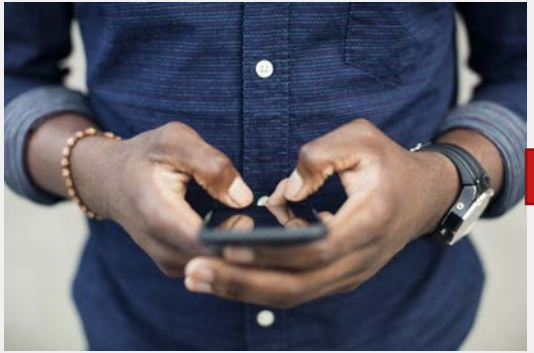
WP5
Agricultural and environmental sensing

Agricultural and environmental monitoring TUD & WUR

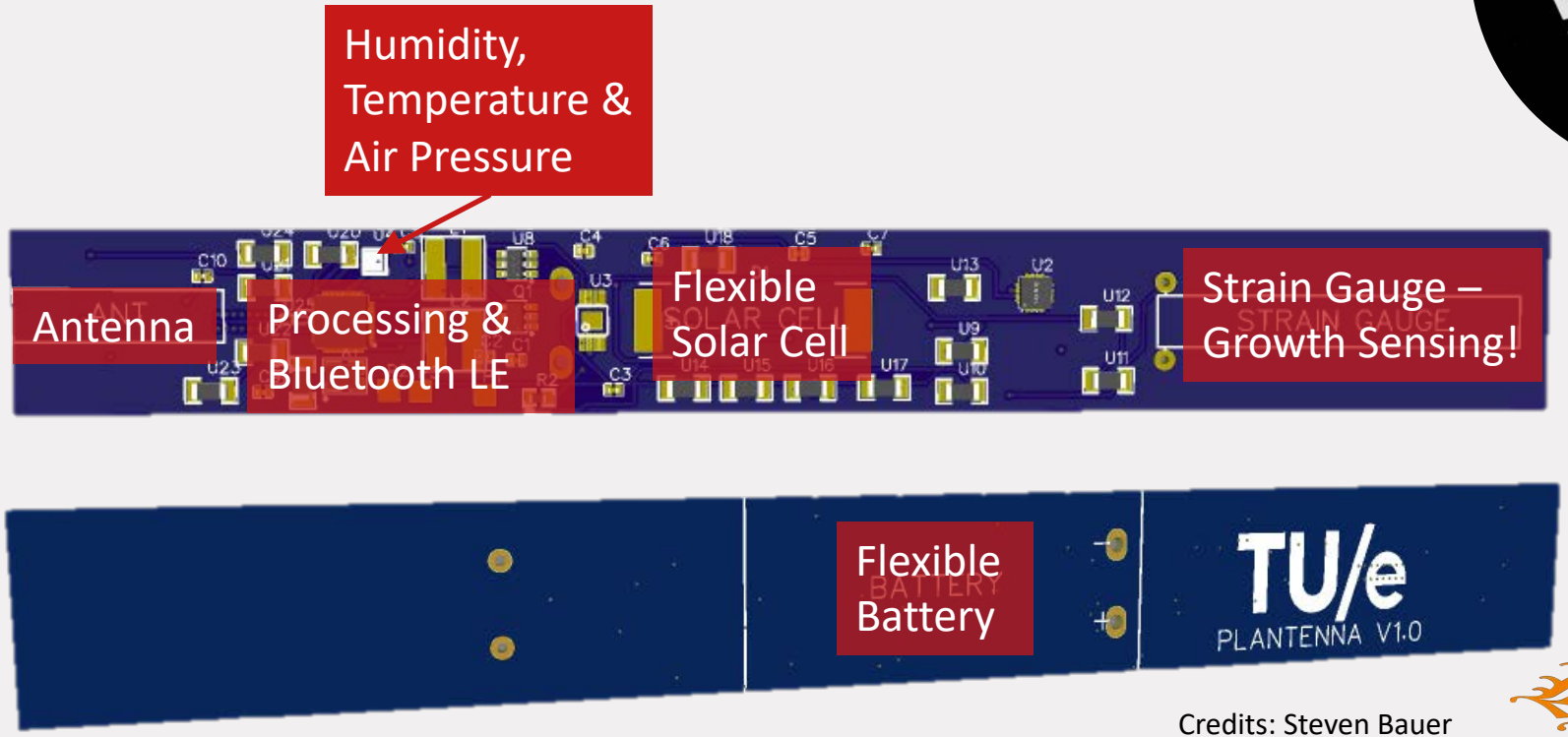
TU/e

The Role of Wireless

Scenario Changes!

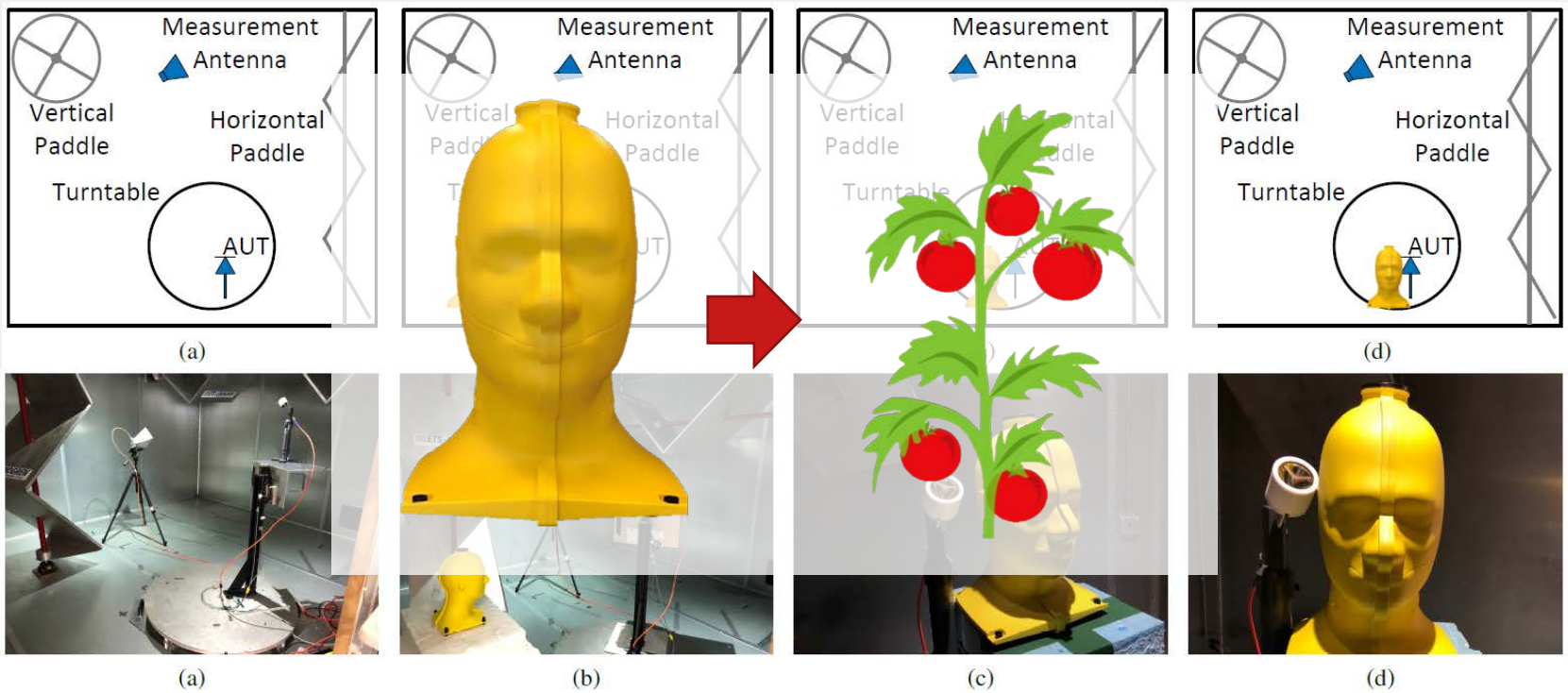


Concept – Flexible PCB V1.0



Credits: Steven Bauer

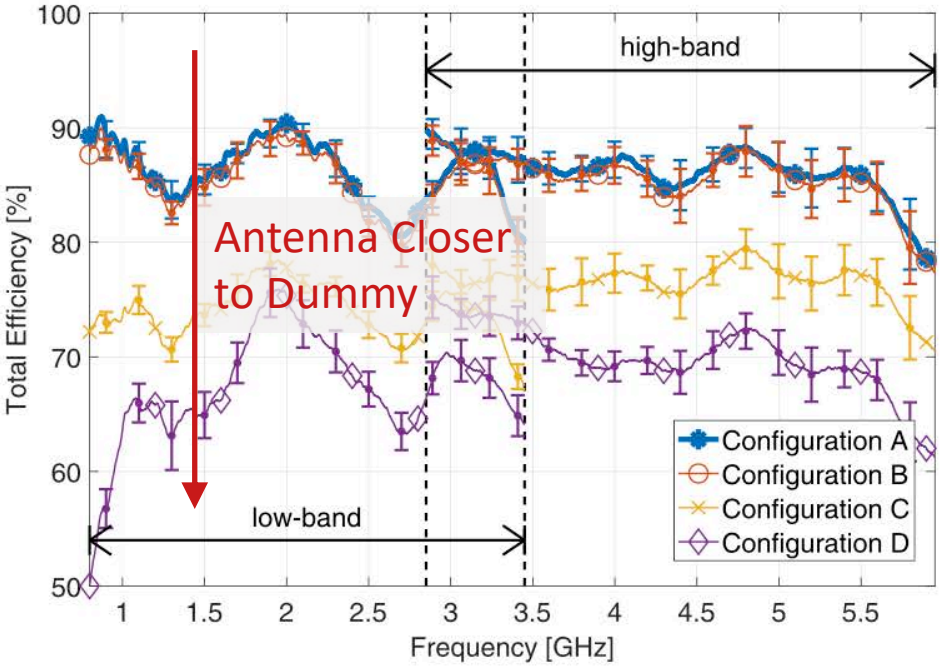
Put Antenna on a ~~Plant~~ Human – Effect?



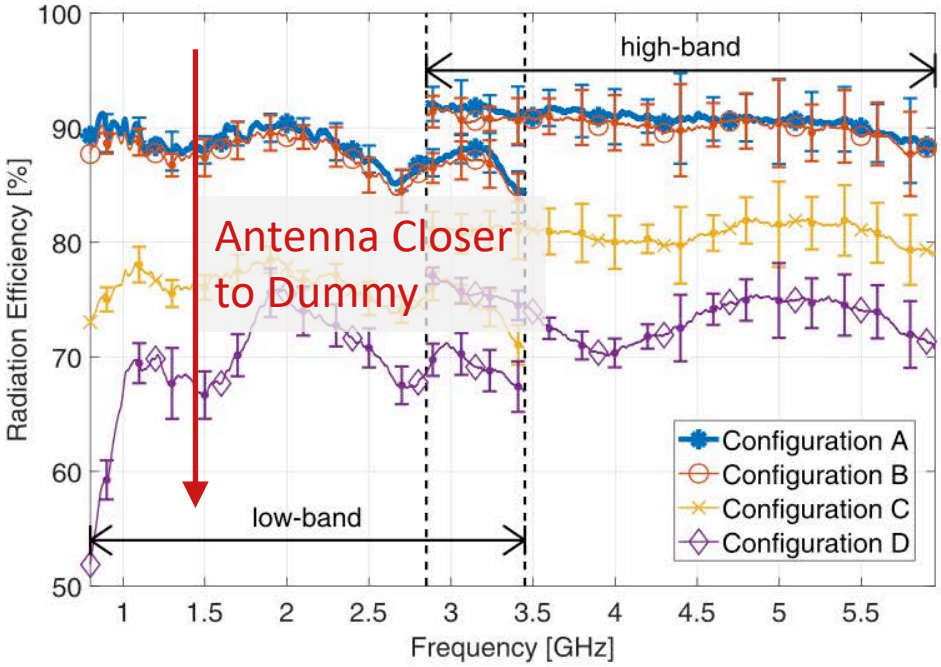
L.A. Bronckers et al., "*Uncertainty in reverberation-chamber antenna-efficiency measurements in the presence of a phantom*," IEEE Transactions on Antennas and Propagation, vol. 68, issue 6, pp. 4904-4915, June 2020.

Put Antenna on a ~~Plant~~ Human – Effect?

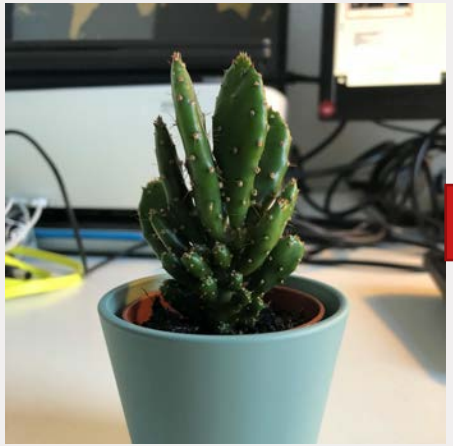
Efficiency Including Mismatch Effects

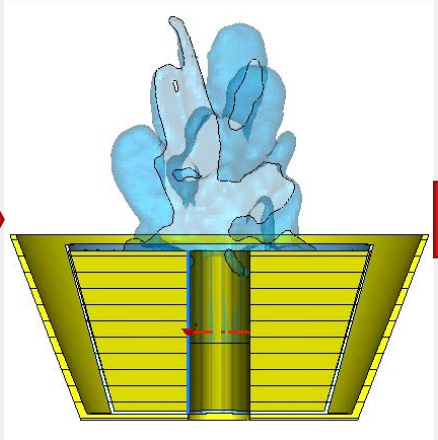


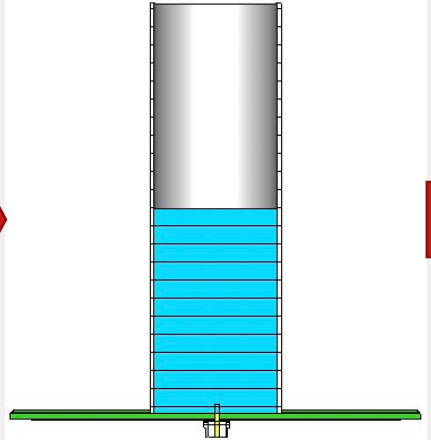
Efficiency Without Mismatch Effects



Use Plant as Antenna?

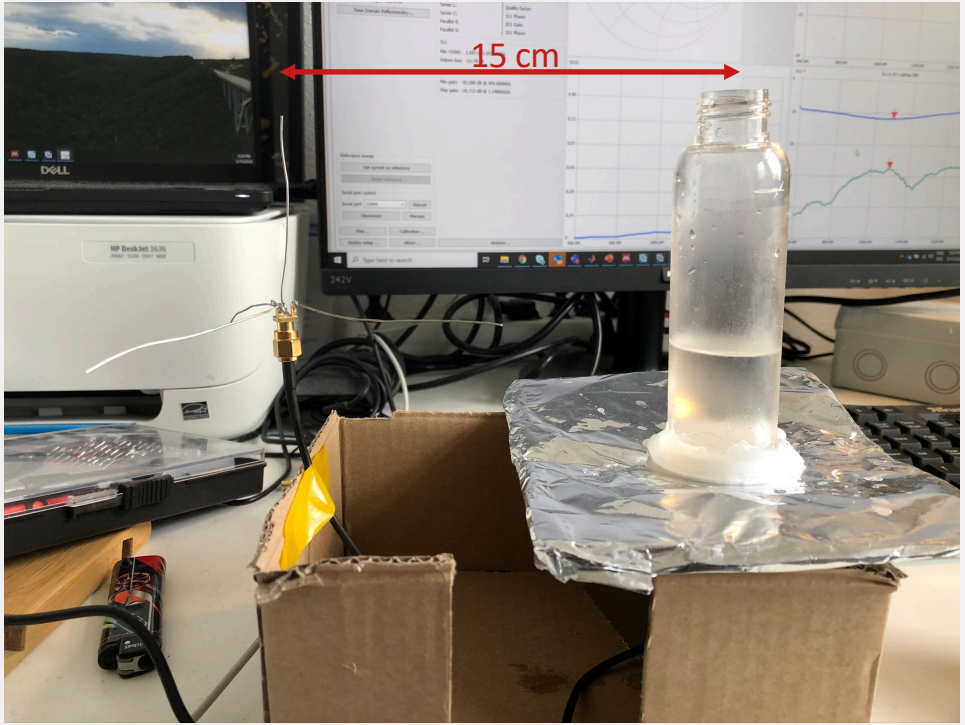


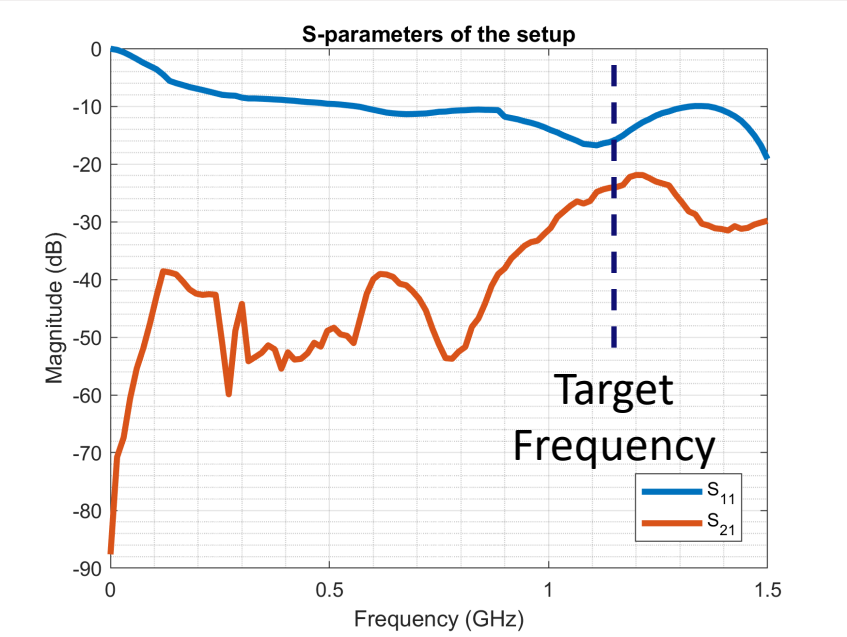




Credits: Tudor Popa

Use Plant as Antenna?



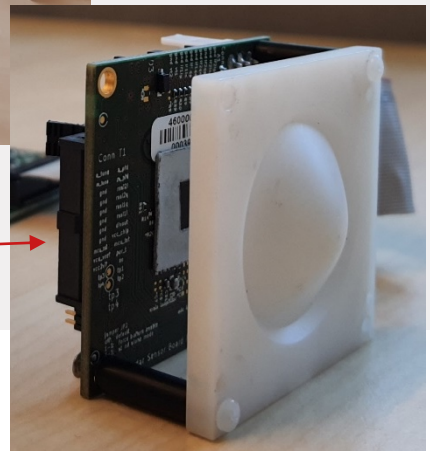


Credits: Tudor Popa

Radar

Corner Reflector

Radar

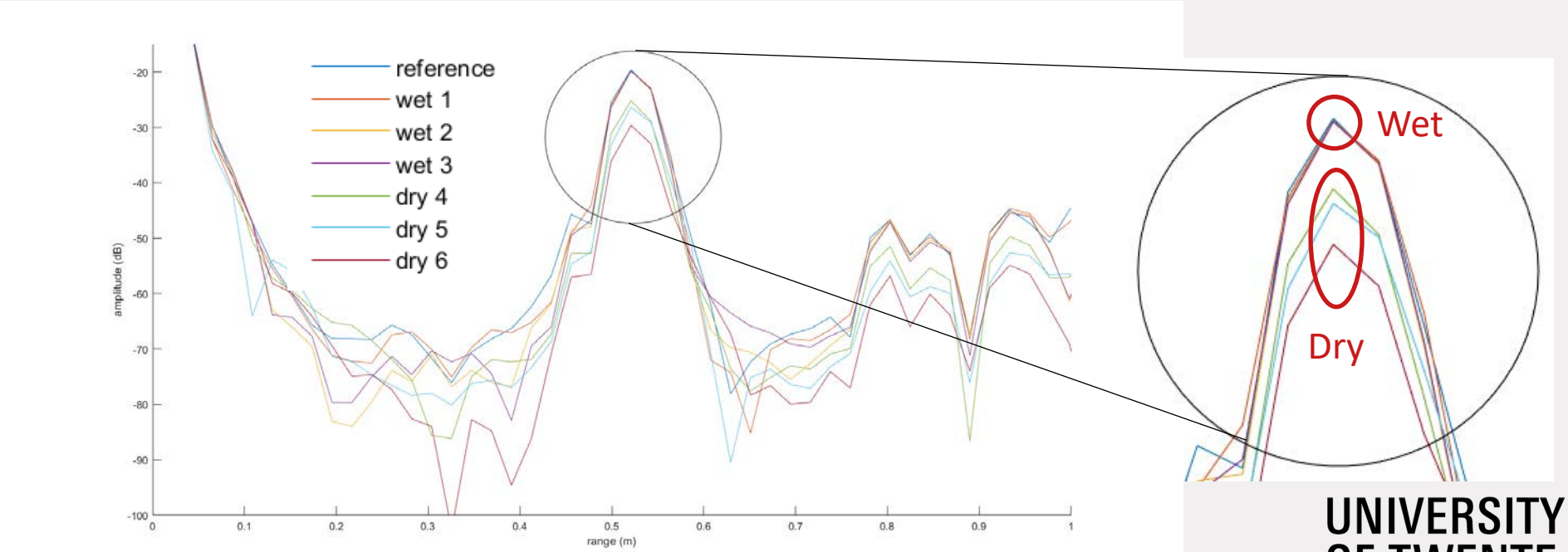


Credits: Natalia Antonyuk

UNIVERSITY OF TWENTE.

TU/e

Radar



Credits: Natalia Antonyuk

UNIVERSITY OF TWENTE.

TU/e

Many Thanks From/To...

Dr. ir. Harijot Bindra

Assistant Professor @ UTwente, Integrated Circuit

Low-Voltage Low-Energy Design techniques for readout circuits and data conversion

h.s.bindra@utwente.nl

Dr. Vojkan Vidojkovic

Associate Professor @ TU/e, Integrated Circuits

RF & mm-wave circuits for sensing & communications, integration of electronics and plants

v.vidojkovic@tue.nl

Dr. ir. Sander Bronckers

Assistant Professor @ TU/e, Electromagnetics

Metrology for Antennas and Wireless Systems

l.a.bronckers@tue.nl

Natalia Antonyuk, Steven Bauer, Tudor Popa, ...

And the rest of the plantenna team!

https://www.4tu.nl/plantenna/en/