

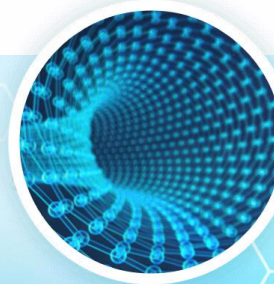


LOW-COST INNOVATIVE TECHNOLOGY FOR WATER QUALITY MONITORING AND WATER RESOURCES MANAGEMENT FOR URBAN AND RURAL WATER SYSTEMS IN INDIA

The LOTUS journey

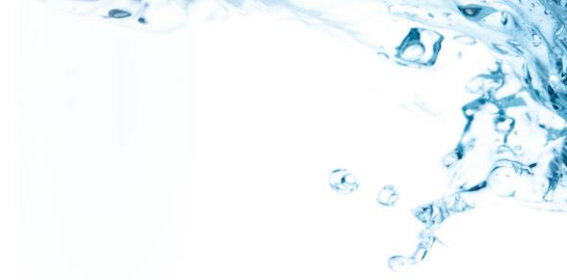
Dr Svetlana Klessova, G.A.C. (France), Dr Bérengère Lebental, Université Gustave Eiffel (France), Prof. Senthilmurugan Subbiah, IITG (India)

And the LOTUS consortium



LOTUS is co-funded by the European Commission under the Horizon 2020 research and innovation programme under Grant Agreement N° 820881 and by the Indian Government, Ministry of Science and Technology.

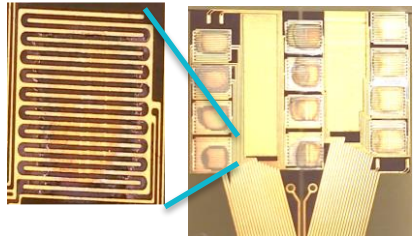




The LOTUS project

The LOTUS project

- **Objective:** Co-creation of innovative **affordable** technologies for India's water challenges
- **Main use cases:**
 - Drinking water system management (Guwahati)
 - Irrigation system management (Jalgaon)
 - Tanker-based water distribution system (Bangalore)
- The main outcome of LOTUS: A novel multiparameter water quality sensor



Based on the novel sensor chip

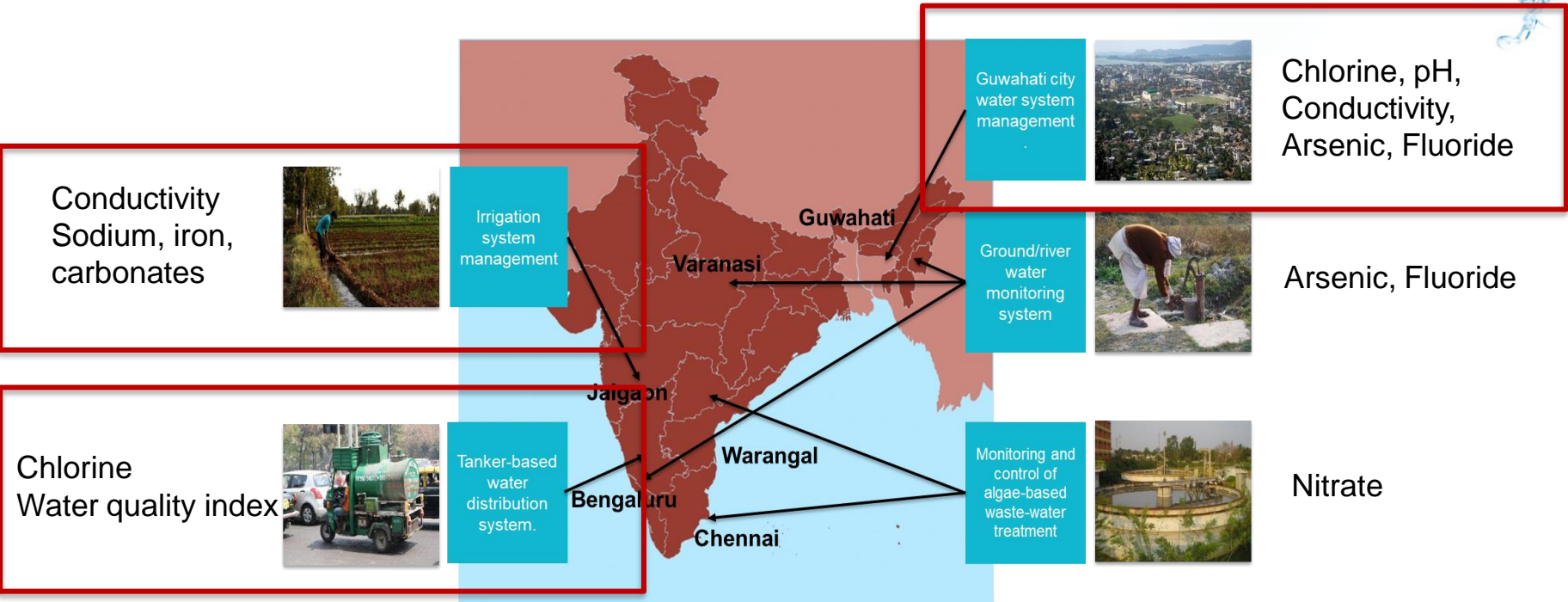


Complete sensor with the LOTUS CNT chip



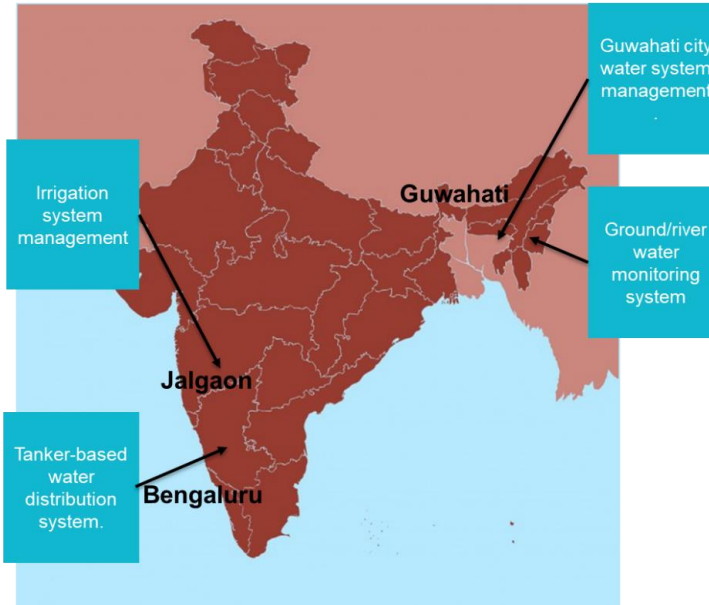
The LOTUS Box to connect the sensor to IT systems

LOTUS use cases in India



4 co-creation workshops with Indian end-users

A total of **80** participants



Further developments by LOTUS

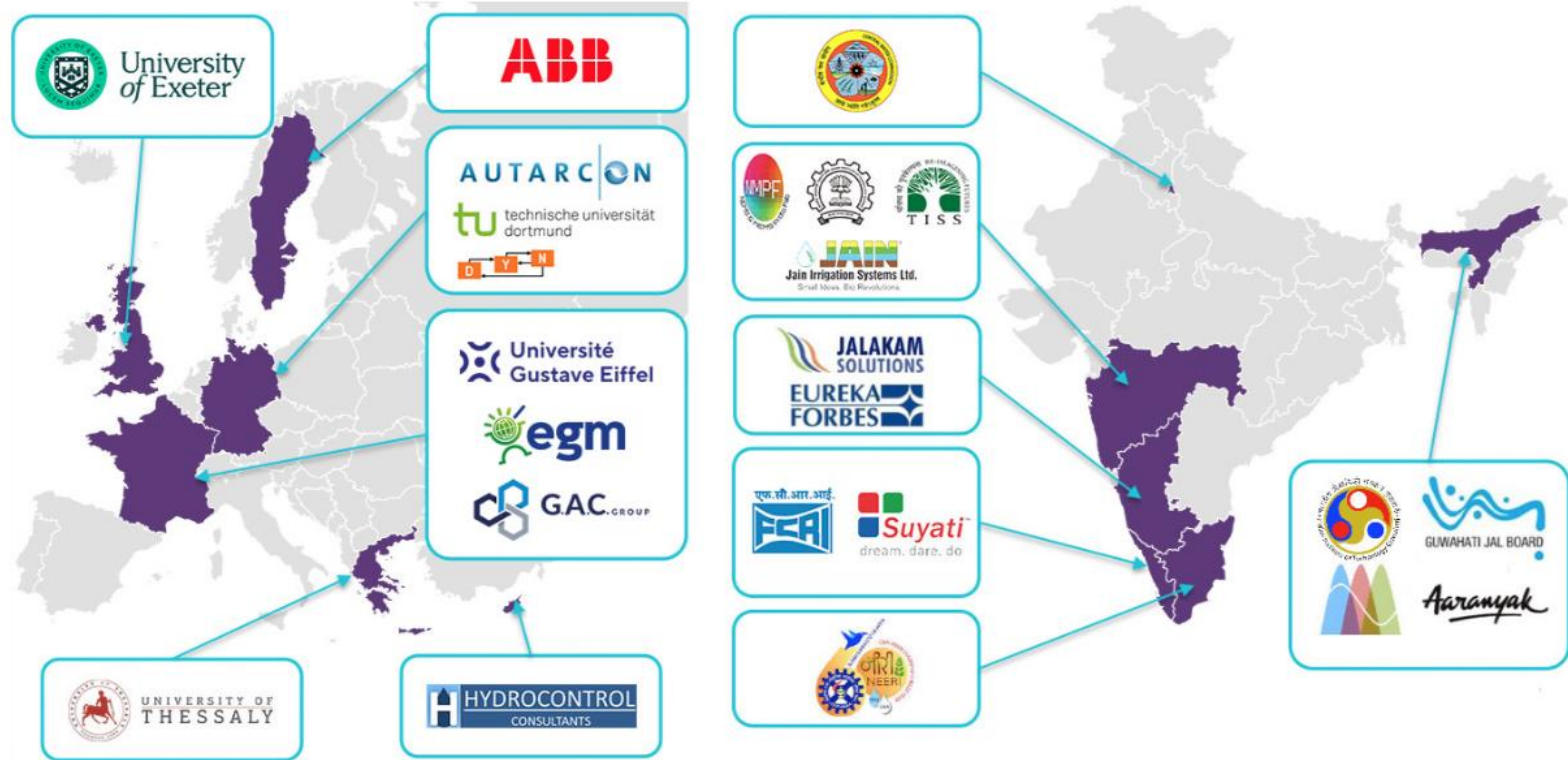


- Solar-powered chlorine generation system
- Software platform for the integration of the LOTUS sensor and other sensors
 - with applications for visualisation, monitoring and control
- Method and algorithm for optimal placement of sensors in piped water systems
- Leak detection algorithm for piped water systems

Further developments by LOTUS

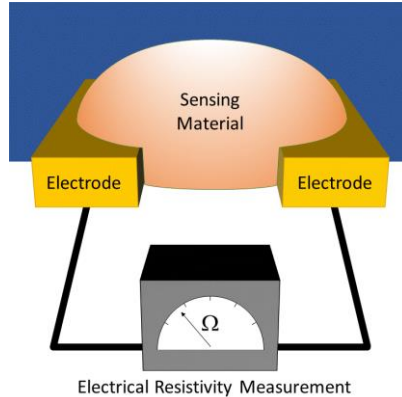
- Coordinated optimisation of disinfectant dosing in large-scale water distribution networks
- On-board control system for the chlorine level of the water in tankers
- Tanker fleet management system
- Method and algorithm for the optimisation of the water usage in irrigation ...

The LOTUS partners: research, industry, NGOs

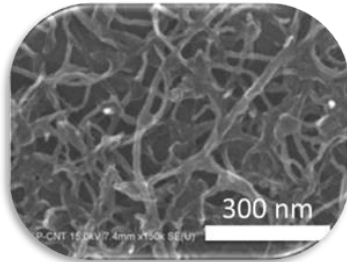
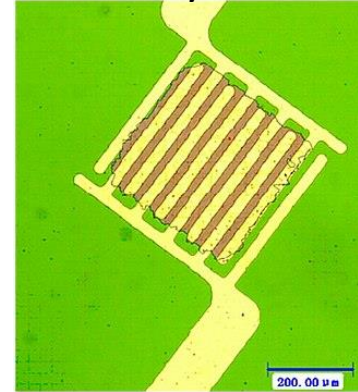


LOTUS concept : electronic tongue based on the end-to-end integration of a carbon nanotube-based chemistor array

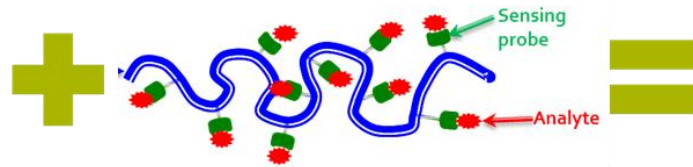
Chemistor



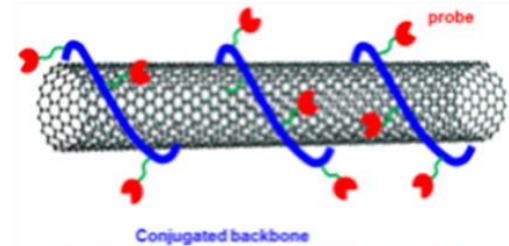
Interdigitated electrodes with chemically-sensitive coating



Carbon nanotube network



Patented family of Conjugated polymers

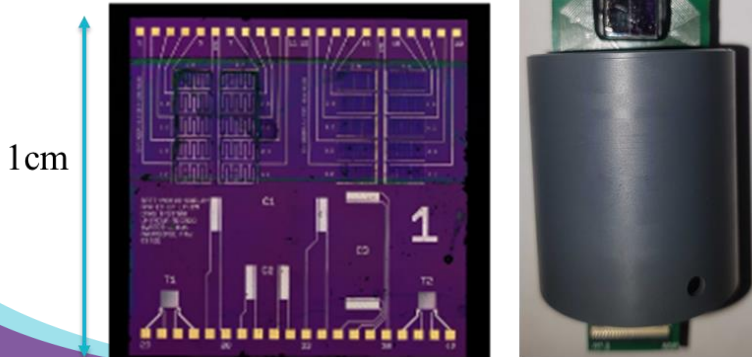


Versatile family of nanohybrids

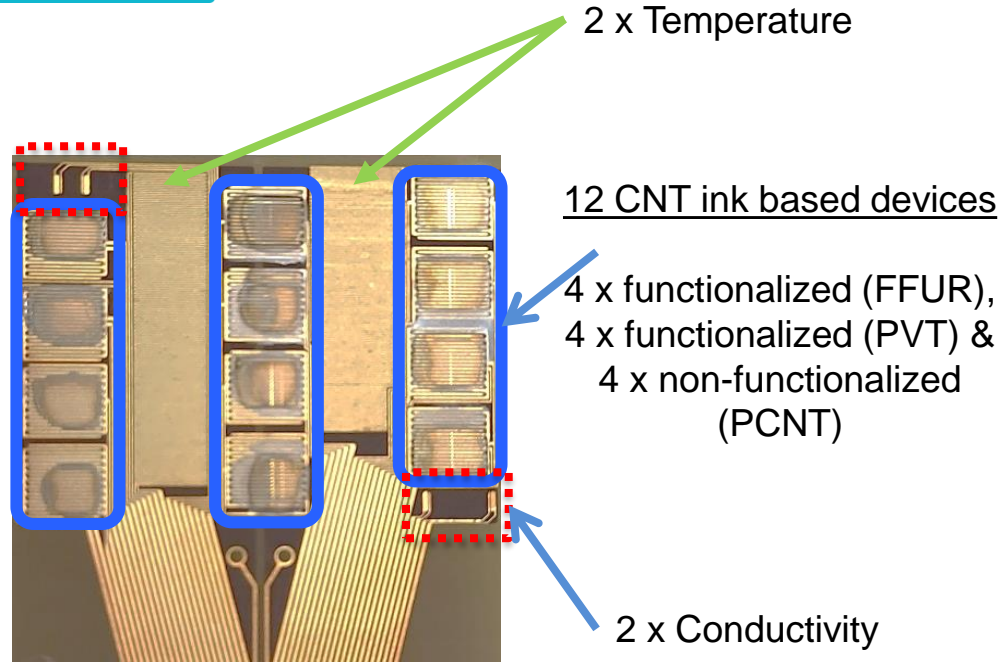
Goal: the LOTUS sensor meeting the Indian market

- LOTUS 1st version initiated from EU design (typical sales cost 4 000€/INR 4 Lakhs)
- **Major requirements for India: Affordable solution**
 - ~500 €/INR 0.5 Lakhs range
 - (~10 x less than European market)
- **Solution: LOTUS 2nd version**
 - From silicon to plastics-based sensor chip

Silicon: >10€/cm²



LOTUS concept : e-tongue based on the end-to-end integration of a carbon nanotube-based chemistor array



PCNT = Pristine CNT ink; FFUR, PVT = Functionalized CNT inks

LOTUS sensor architecture



Targeted parameters



Temperature

0-50°C
±0.1°C



Chlorine

0-5ppm
± 0.01mg/L



pH

5-9
±0.1



TDS

0-2000µS/cm
±20µS/cm



Arsenic

0-200 ppb
±5ppb



Pressure



Fluoride

0-40 ppm
±0.5ppb



Flow



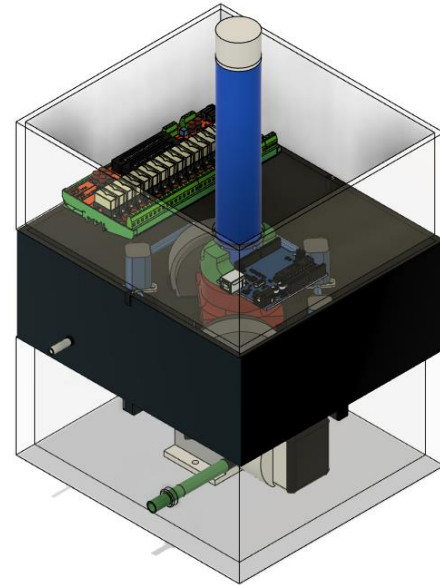
External commercial sensors

The LOTUS sensor installation

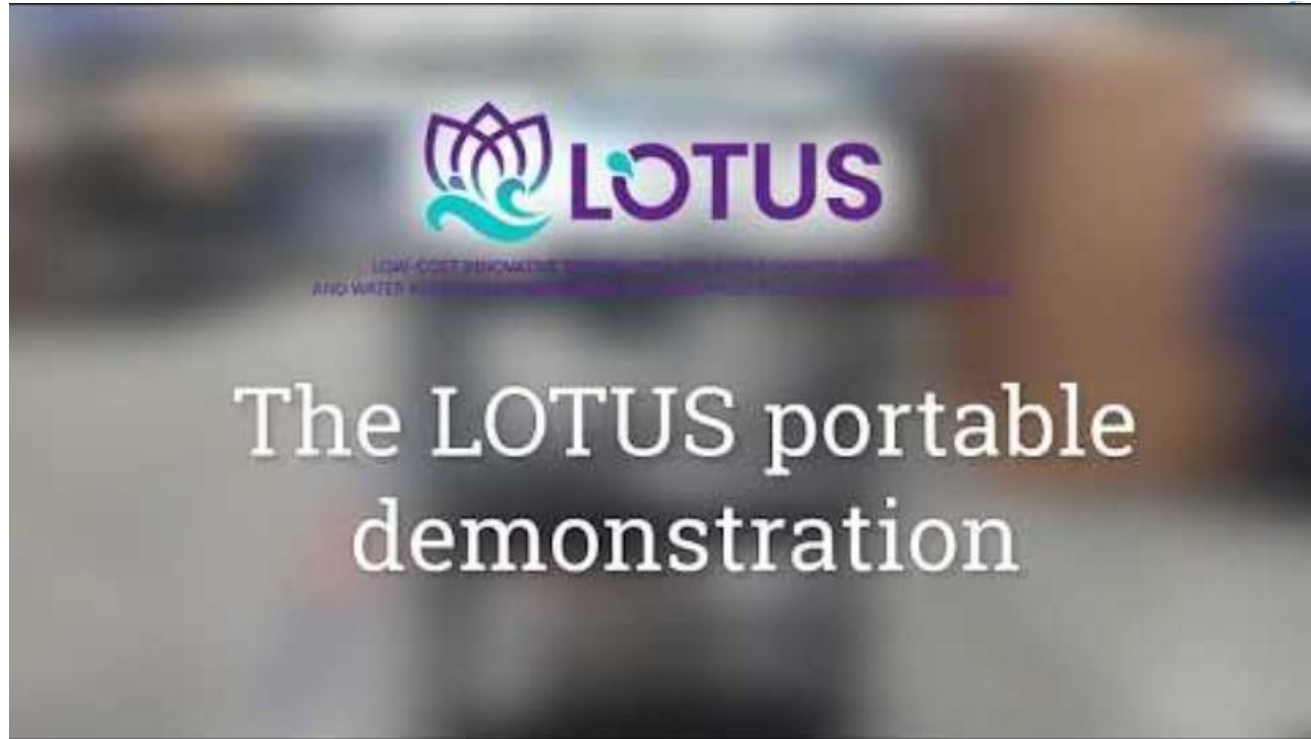
- In-line installation



- Through bypass



The LOTUS portable demonstration



https://youtu.be/UU7AG_tNkyM

Benefits for customers



Plug and play installation



Long sensor life



Less maintenance



No field calibration



Real time



Low cost

Technology transfer



- **Technology transfer of the LOTUS sensor through Hydroscope (Indian startup spin off from Uni Eiffel and IIT Guwahati):**
 - Letter of intent signed with Hydroscope for pre-LOTUS patent FR3064999B1 and subsequent LOTUS know-how
 - Two joint LOTUS patents (IITG, Hydroscope, Université Paris Cité and CNRS) to be exploited by Hydroscope:
 - N°FR2315497: Dispositif pour l'analyse d'un fluide comprenant une tête de sonde
 - N°FR2315496: Dispositif pour l'analyse d'un fluide comprenant une portion de conduit
- <https://hydroscope.in/>

The LOTUS sensor commercialisation with Hydroscope

- An Indian start-up, Hydroscope Technology Pvt Ltd has been created:
 - To commercialise the LOTUS sensor in India (and beyond)
 - As a direct outcome of the LOTUS project
 - A spin-off of two universities and a private company: Uni Eiffel (Paris, France), IITG (Guwahati, Assam), Pyrotech Workforce (Udaipur, Rajasthan)
- Creation of the chain of values around Hydroscope:
 - Partnership with a French company for the industrialisation of the sensor chip production
 - Partnership with Indian companies for electronics and system integration
 - Multiple client testing performed
- Volumes: we plan to reach the production of 1 000 units this year and 10 000 units next year

Solar-powered Chlorine Generation System and High Recovery RO system

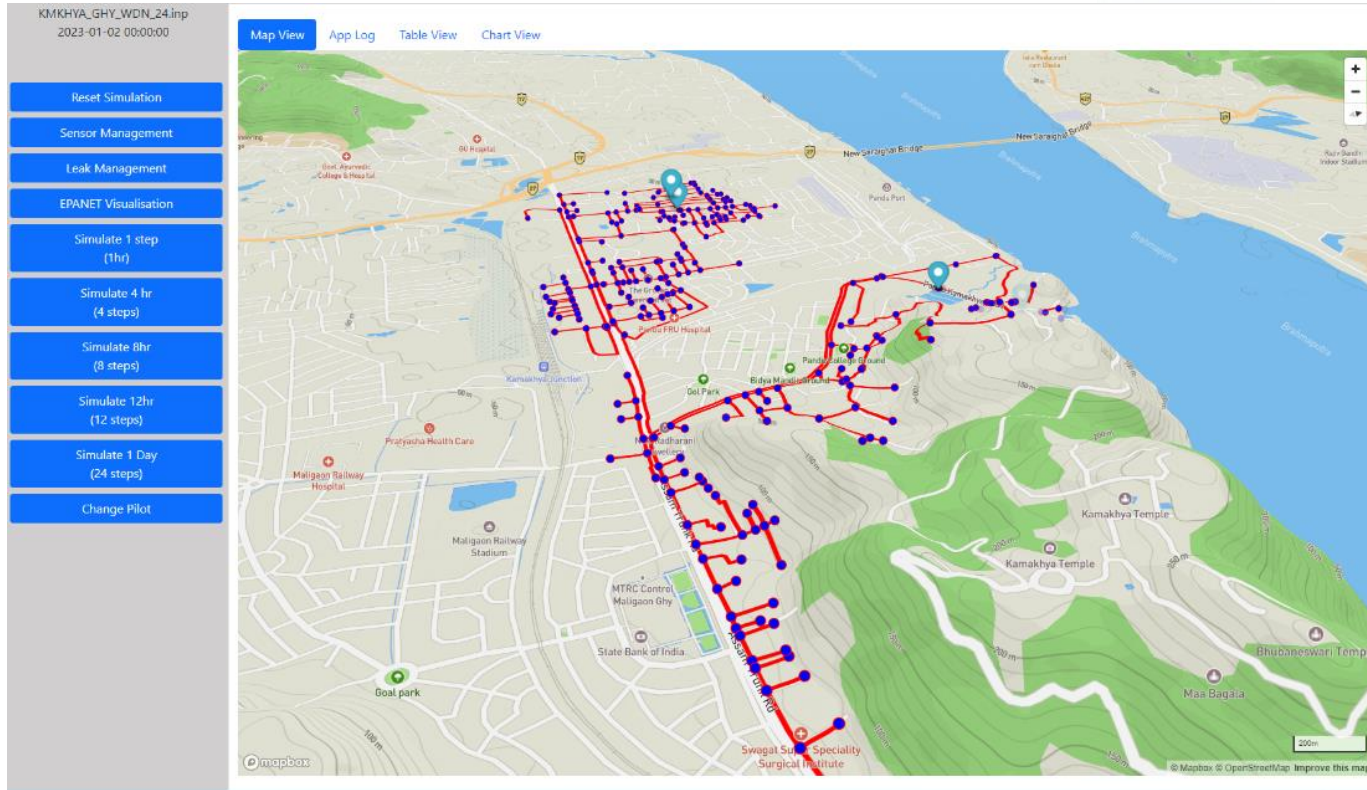
High Recovery RO system



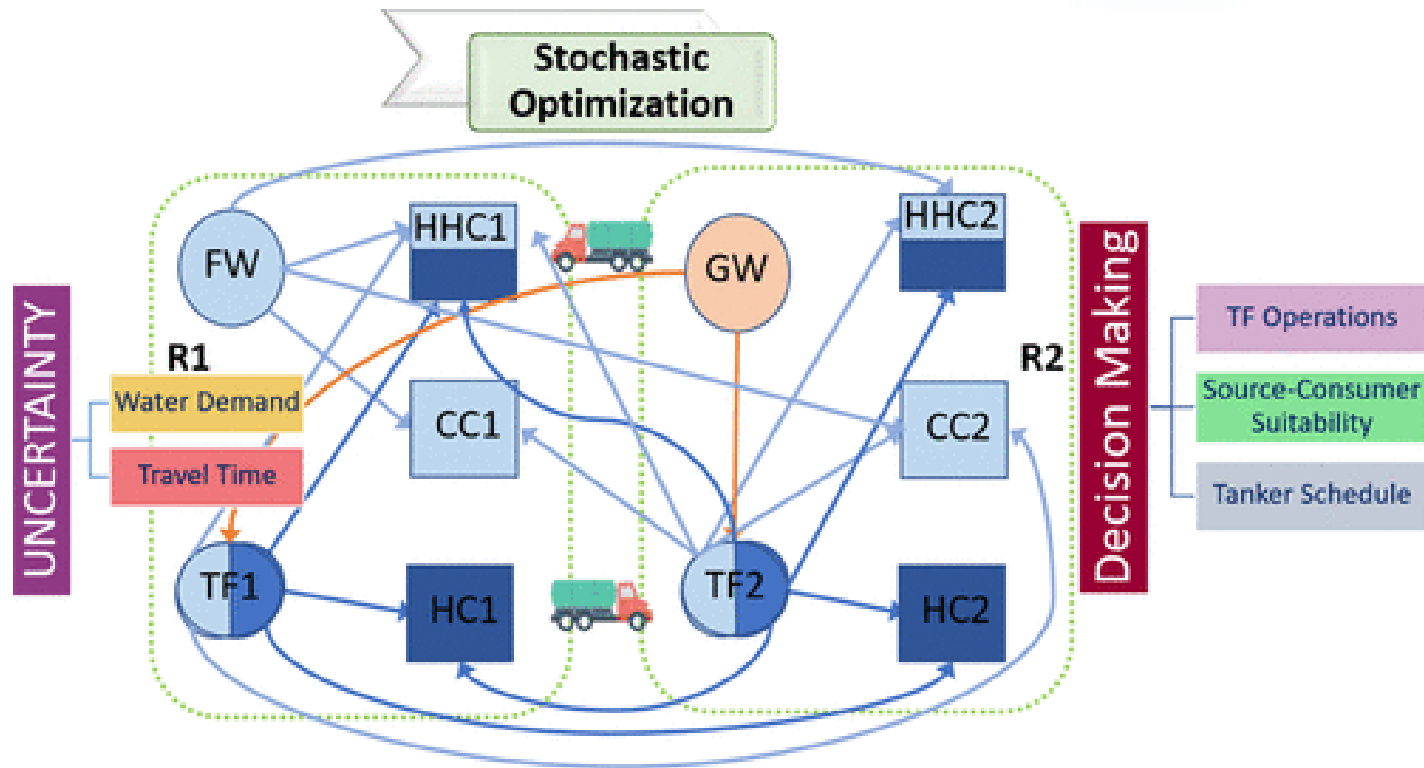
Chlorine Generation System



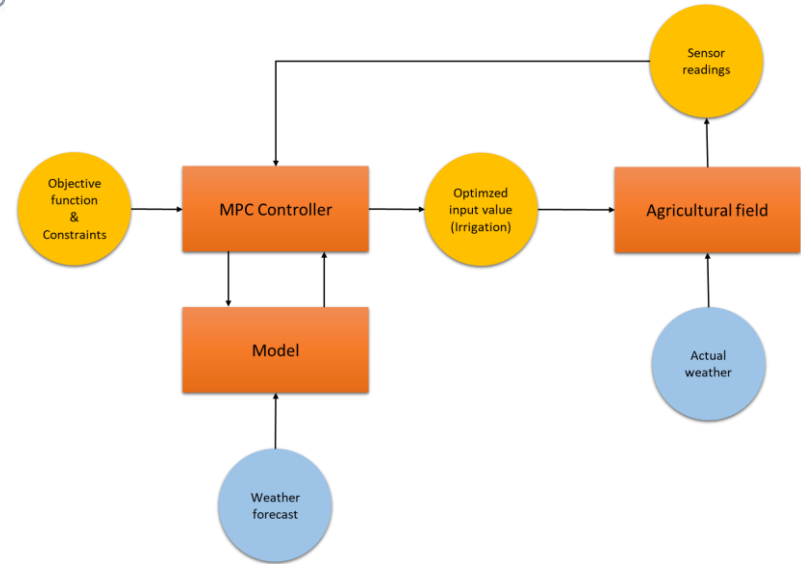
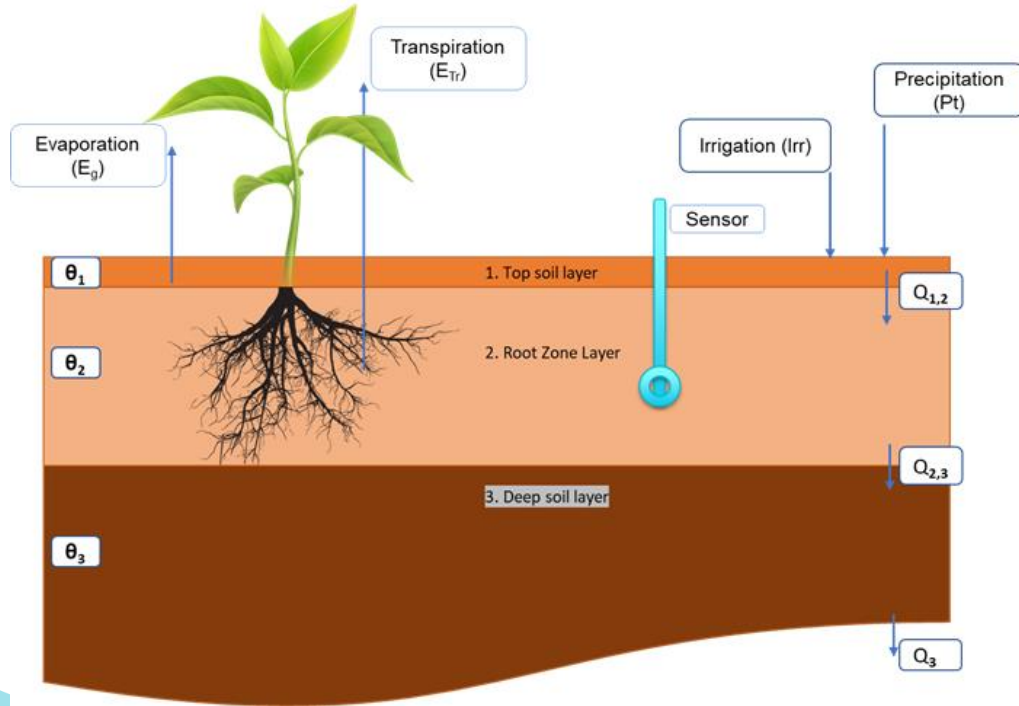
Fiware-based leak simulation and visualisation platform



Planning framework for the operation of water tankers



Water quantity optimisation in irrigation



Knowledge transfer

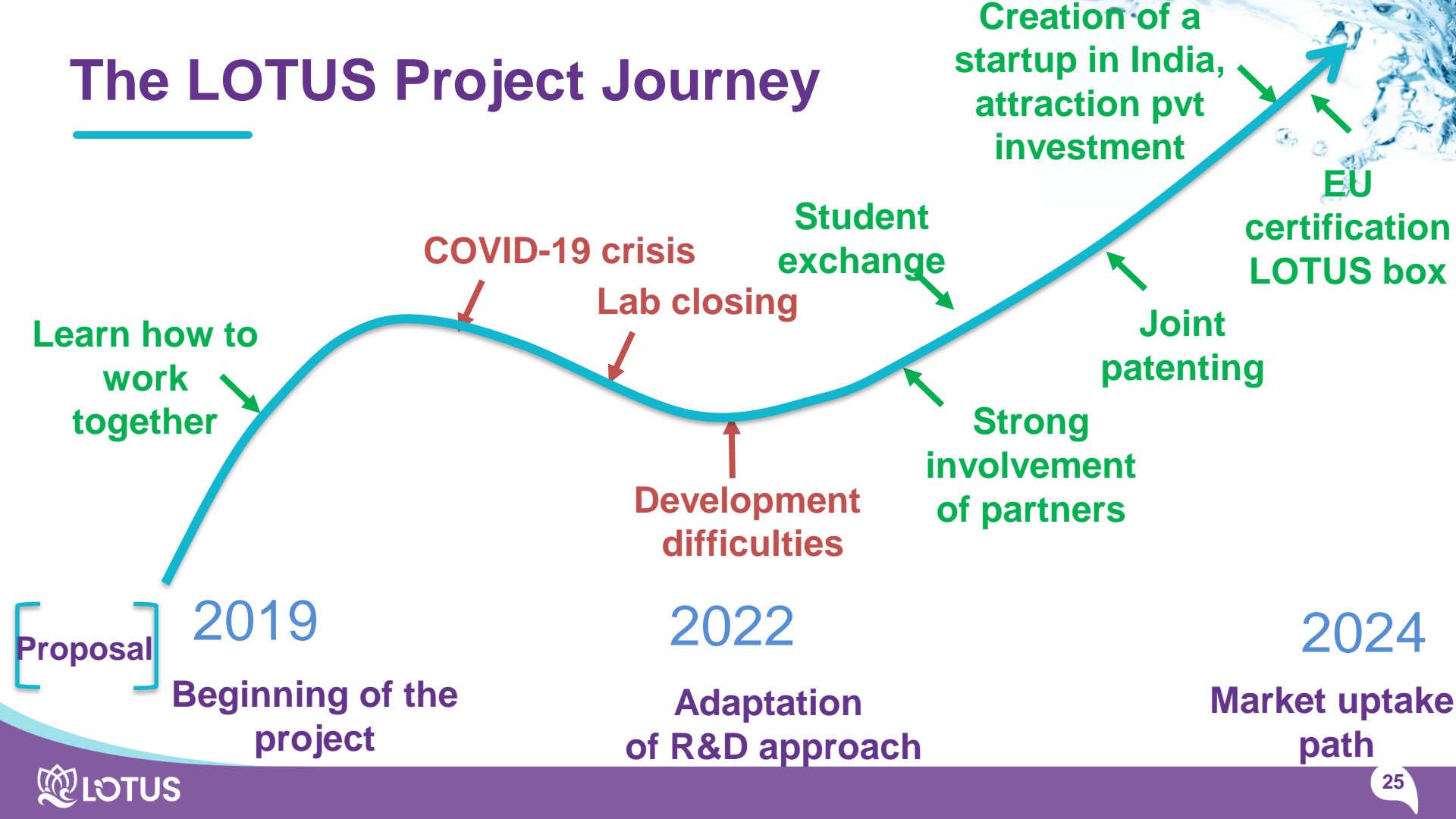
- **Training of Indian labor to use the LOTUS chlorination unit:**
 - AUTARCON installed its chlorination unit for the treatment of water at the IIT Guwahati, in India and provided training to the local unexperienced labor to be able to install, operate and repair it.
 - These trainings involved: system installation (drilling, sawing, screwing, etc.), piping, plumbing and pumping, solar power supply systems, data monitoring systems, water quality analysis
- **Training of field service workers for managing water for irrigation:**
 - Training of local field workers to use the algorithm for efficient management of irrigation water for an onion crop on a daily basis on their mobile phone
 - By following the recommendations on water quantity, good results were obtained: no crop damaged and significant amounts of water saved
- **Student exchange**



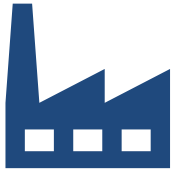


The LOTUS journey: our story

The LOTUS Project Journey



Where we are now (January 2024)



Strong exploitation perspective through industrials involved in the project (Hydroscope, Jain Irrigation, Eureka Forbes, etc.)



Deep established collaboration between Europe and India



Lessons learnt about collaboration between India and Europe

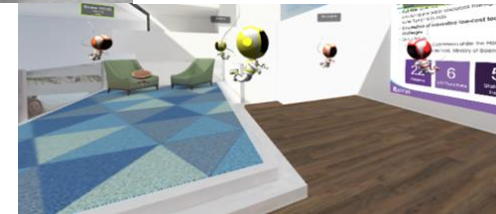


The LOTUS virtual fair

- The LOTUS fair is a 3D online environment that showcases the LOTUS solutions and the results of the LOTUS project.
- It provides:
 - Spatialised audio
 - 3D objects can be manipulated (LOTUS box, LOTUS sensor)
 - Interactive posters and videos
 - Meeting rooms



Scan me !



Final words...



It was challenging but we are happy to have gone through this experience



It's not the end of the journey but it's the beginning of the **journey to the market!**



Thank you the EC, Indian Government, investors of the startup, and the LOTUS team – you made it happen !

And we remember...

« Change is the only permanent » (our Indian partners)

« The only constant in life is change » (Heraclitus)