

**Institut français
des sciences et technologies
des transports, de l'aménagement
et des réseaux**

**Components and Systems (COSYS)
Towards smarter cities, transport, infrastructures
RDI for 2017-2021**

6 Décembre 2017

Frédéric Bourquin, Head , COSYS
Jean-Patrick Lebacque, COSYS
Nour-Eddin Elfaouzi, COSYS



IFSTTAR



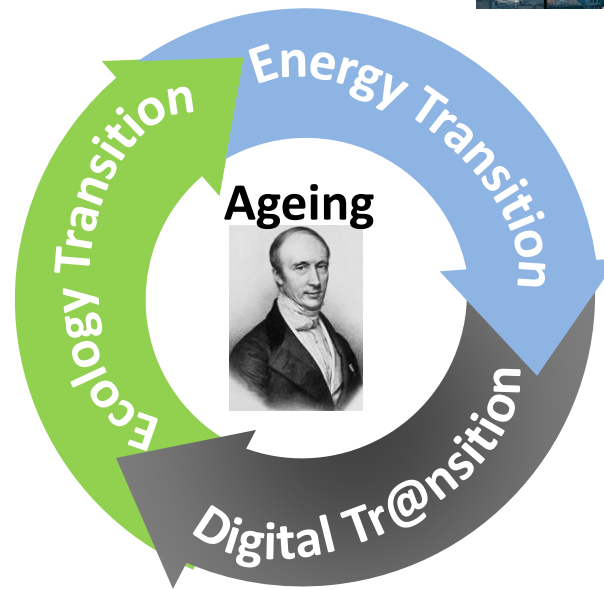
COSYS : Mega-trends, Challenges



Green clean efficient Mobility
congestion, GHG, particles...



Carbon neutral, @ttractive
healthy cities, HL services



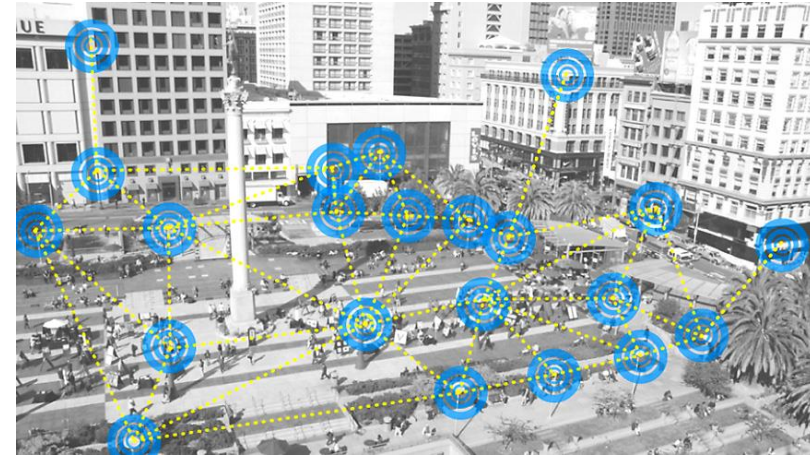
Climate Change adaptation, mitigation

Resilient cities
and mobility

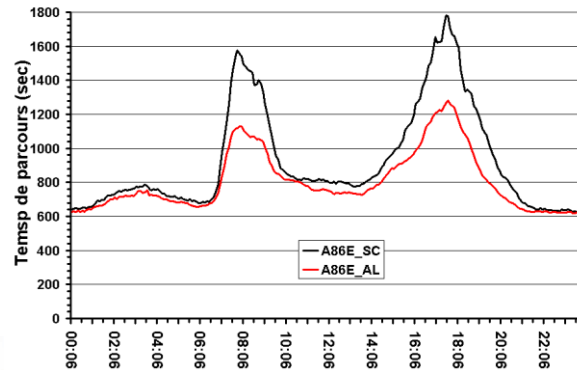


Opportunities (in line with TRB, TRA, TRC, STRIA, Cavita...)

IoT



**DATA
ANALYTICS**
Sensor, Calculus



Control
A86E
A6, A125



Intelligence for mobility and cities

- ❑ 270 employees incl 65+ PhD students (20 industry-supported), 50 postdocs
- ❑ 11 laboratories (+ several joint labs) at 7 locations B<20M€
- ❑ Yearly >120 journal papers, 4-8 patents
- ❑ 2013 : **most influential paper** of last decade in machine vision
- ❑ 2015 : **2 world records** on nanoelectronics for advanced sensing
- ❑ 2015 : **1 ERC Consolidator Grant + 1 Career Integration Grant**

INNOVATION

- ❑ Generated more than **90 patents**
- ❑ Created **>60 jobs** in the private sector
- ❑ Created **8 start-ups**
- ❑ Coop : **ESI**, Renault, Alstom, Transdev, RATP, SNCF, Mitsubishi, VALEO, Eiffage, Vinci, Ingerop, **LYFT**, many **SMEs** ...
- ❑ **2017 : maturing 2 start-ups**

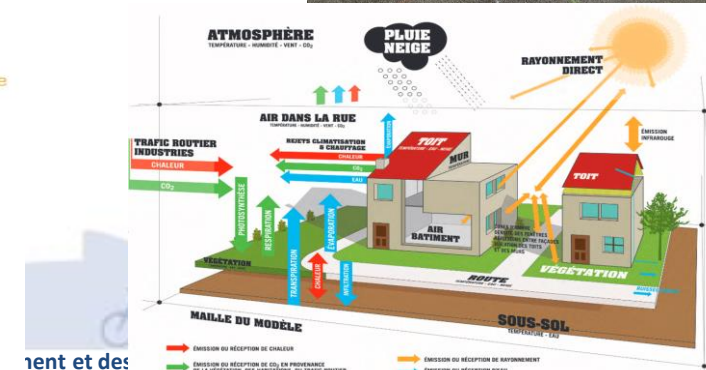
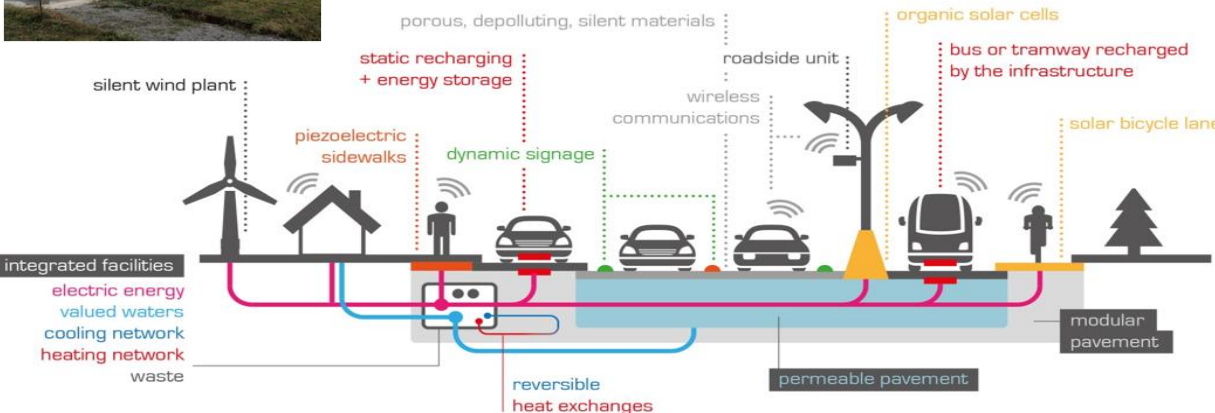
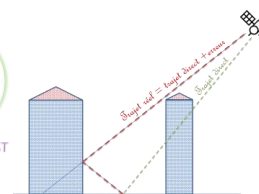
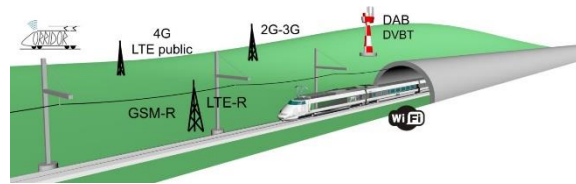
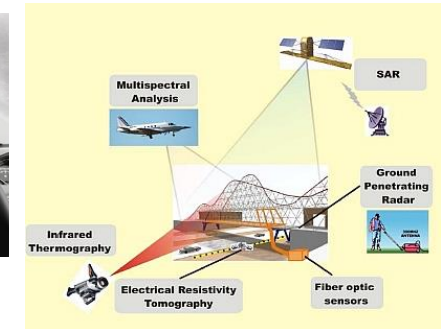
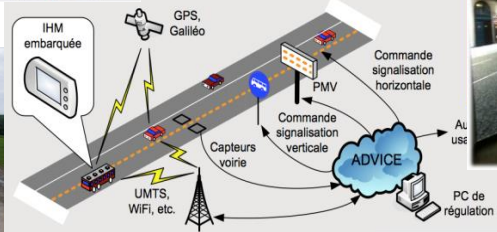
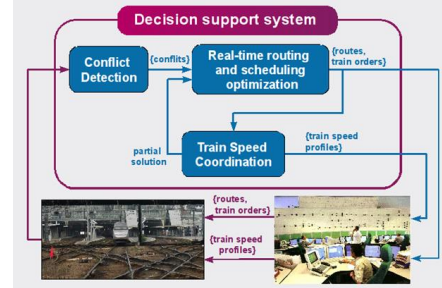
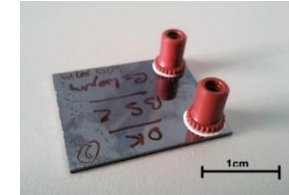
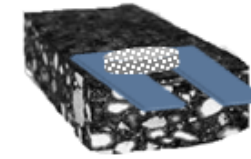
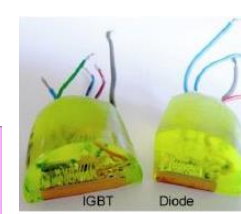
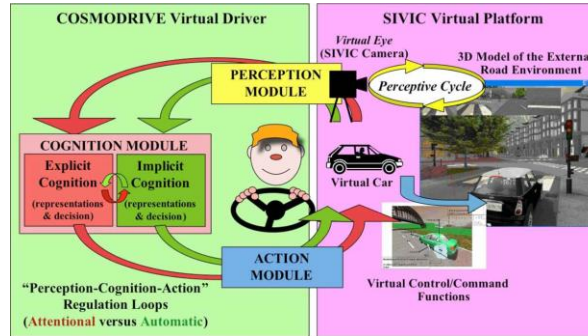
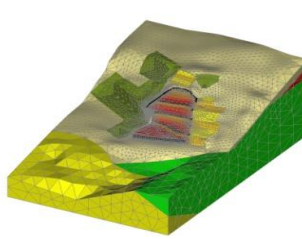
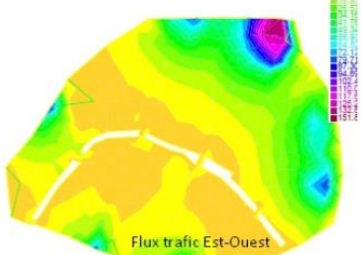
Supporting Public Policies

Yearly 40 appraisals (incl. international)

Structuring European Research Area

- ❑ Heads European NoE **Nearctis** + **Eurnex** + **UERA** + Hycon2, ARTS, Sappart
- ❑ International Joint Labs under creation with **IREA** (Naples), **QUT** (Brisbane)
- ❑ Strong participation in french **Prog. Invest. Avenir** + FP7-H2020

overview

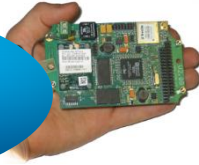


rent et des

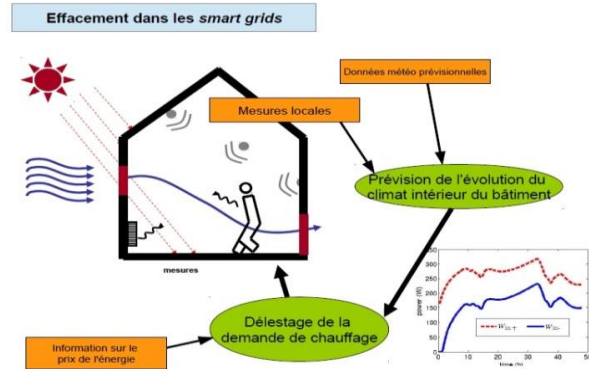
Start-up, supported SMEs, big groups

Smart water networks

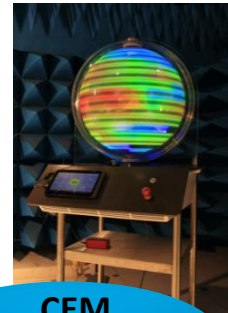
EFS, Sixense, A3IP,
PostMICADO



Nano-WIM Altaroad



Energy audit, DRM: Solamen, Actility Ecotropy, Power-Lan



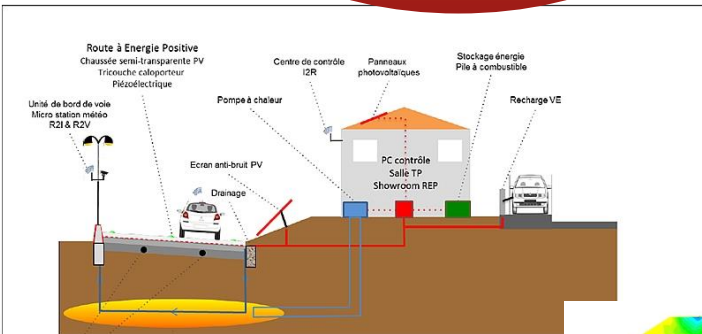
Depolluting concrete UrbaTP

Open innov Highways, Energy efficient roads Vinci, Eiffage, Siemens...

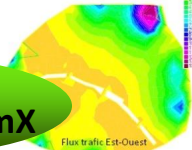
Mobility Citilog, Civitech, Transpolis, Stanley Robotics, TACV, Sixense, GreenT, IGNFAB



EdF, RATP, ENGIE, Vinci...

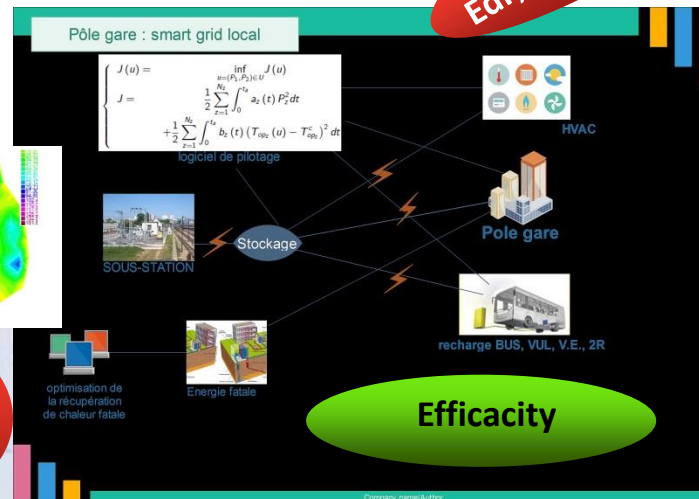


Railenium, VEDECOM, SystemX



Civil engineering ITECH, Vectra Sixense

ESI, Toyota, Mitsubishi, Alstom, Systra...



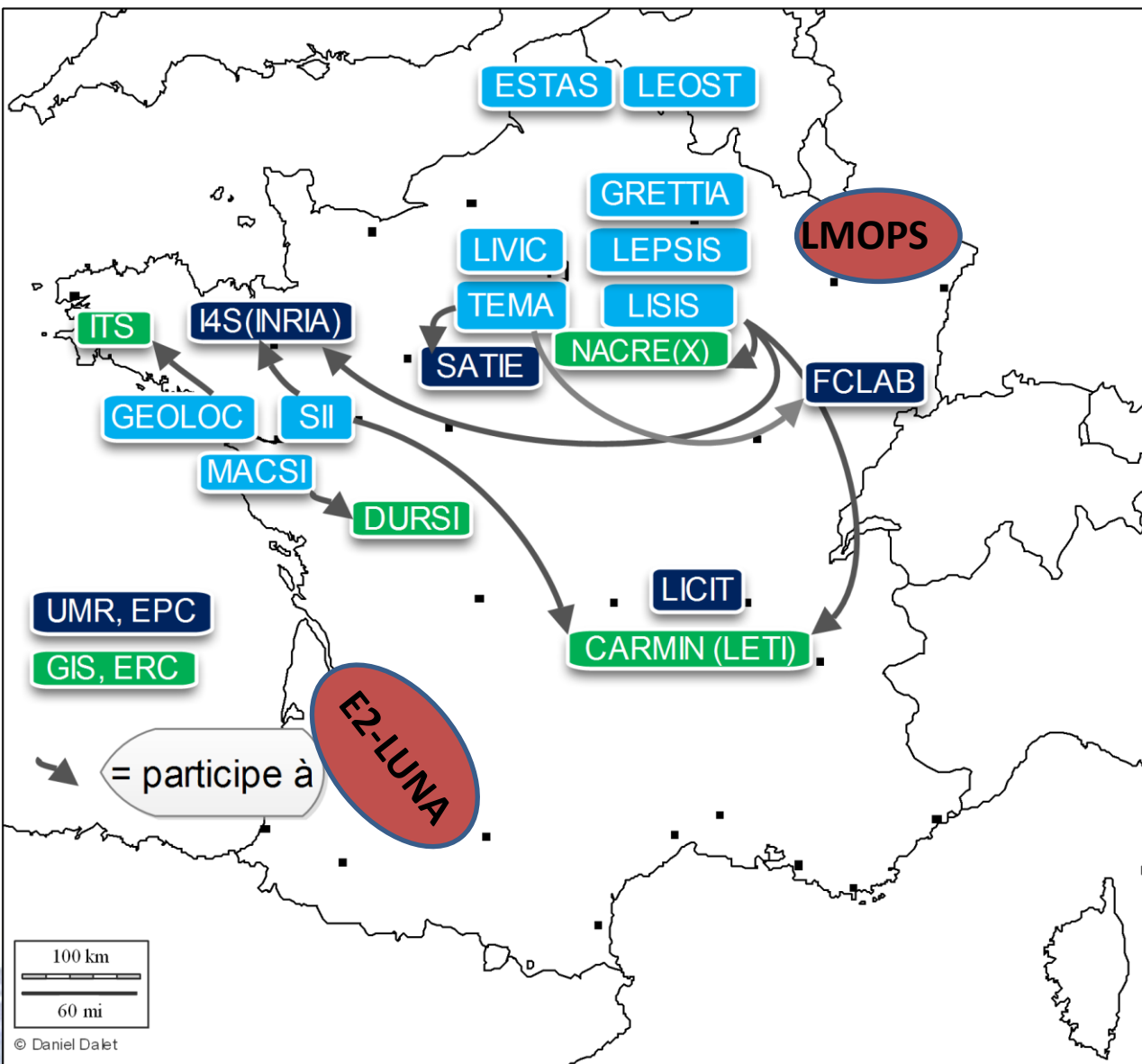
CEM Luxondes

PIA

Start-up

supported SMEs

big groups



NTU, Singapour

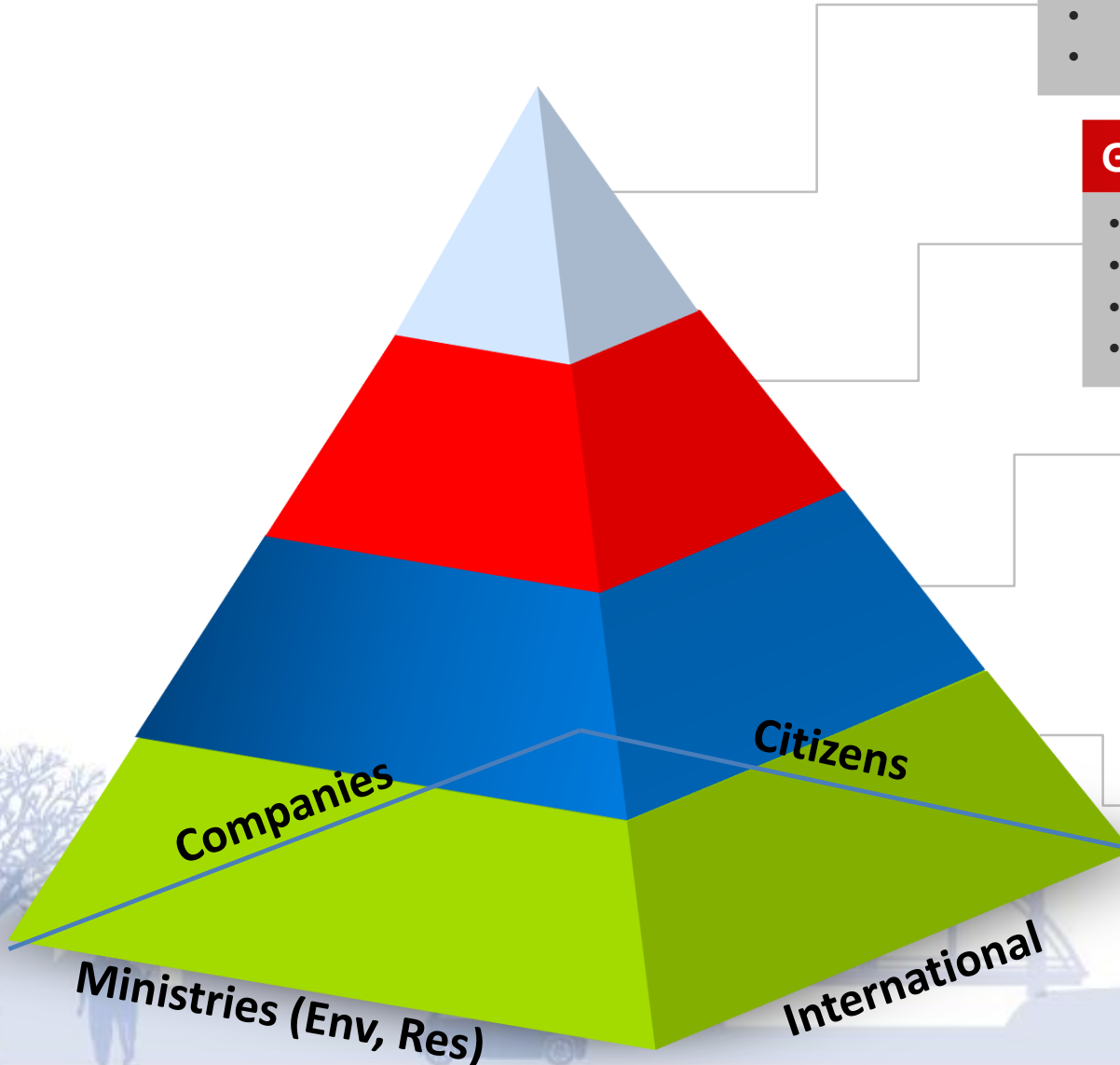
Jiaotong, Beijing
Tongji, Shanghai

QUT, Brisbane

IREA Napoli

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Channeling deep science to useful solutions



TRANSITIONS

- Green
- Energy
- Digital
- Ageing

Goals

- High-level service cities and transport
- Green cities and mobility
- Adaptation to climate change
- Resilience to natural + risks

Macro-topics // STRIA, ITF, TRB

- Next gen Transport Systems (R5G)
- Energy Solutions
- Climate Solutions
- Urban Metabolism and public health
- Security-safety

Scientific pillars

- Models, softwares
- Sensors, power components
- Data, Information and IoT
- Automation, optimization

R5G : 5th generation road

Models and software

- Traffic Modelling and control
- Simulation and displacement simulators
- Finite elements for civil structures

Next gen Transport Systems

Sensors and power transmission components

- Innovative sensors
- Smart materials and structures
- Power, storage components, fuel cells

Security-safety

Urban Metabolism and public health

Climate Solutions

Energy Solutions

Sense-City

Railenium+Shift2Rail

Control and optimization

- Security, cybersecurity
- Critical control system engineering
- Smart grids and energy efficiency

Data, information and IoT

- Big data, statistical Inference, inverse modelling
- Localisation, digitale infrastructure for AV
- Cognitive Radio
- human and artificial vision

Tech. Tranfer

Evaluation Certification Homologation Large projects

Next gen Transport Systems :

Paving the ground to on-demand mobility

Connected Autonomous vehicle

- Ground based + car-borne Technologies to help lateral guidance:
Sivic, novel materials, **Computer Vision**, **Augmented GNSS**
- **Human factors and simulators**
- Towards an *infrastructure readiness level* for Autonomous vehicle
- MaaS : data-driven multimodal **heterogeneous fleet management**



- Hyperloop type of systems



- Enabling Flightpath2050 : towards full multimodality

Simulation with Pro-SiVIC (JV ESI-IFSTTAR)

ESI's **Pro-SiVIC™** : a software platform for **realistic** simulations in 3D virtual environments :

- infrastructures
- road users, vehicle dynamics
- lighting
- **perception sensors**
- all **ADAS**



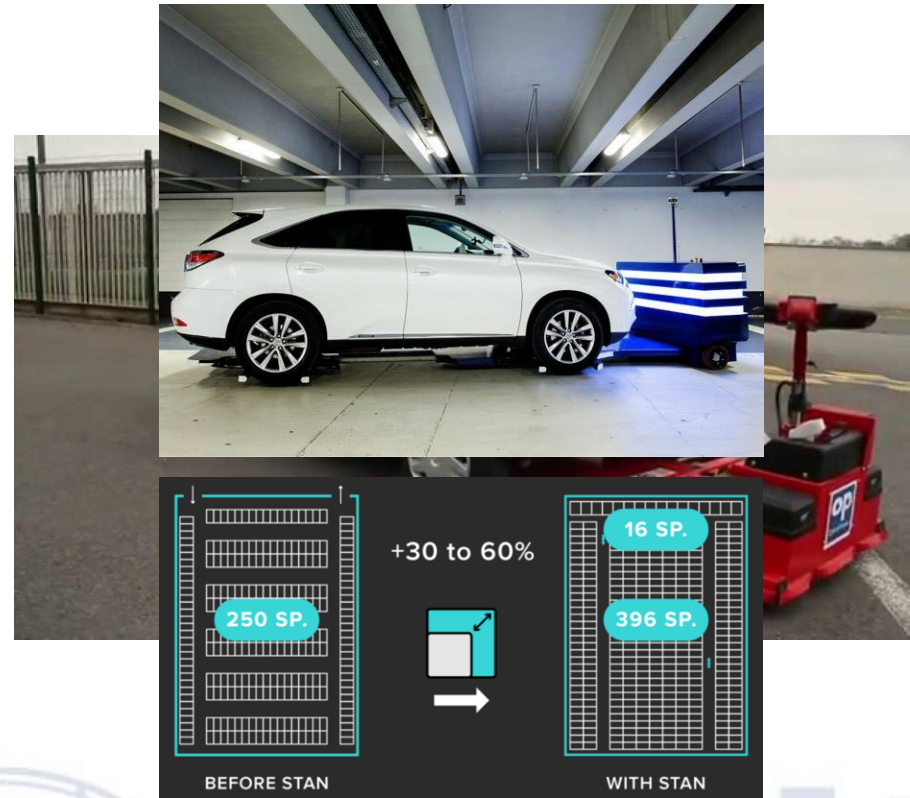
**SHOW CASED at
CES Las Vegas 2017**





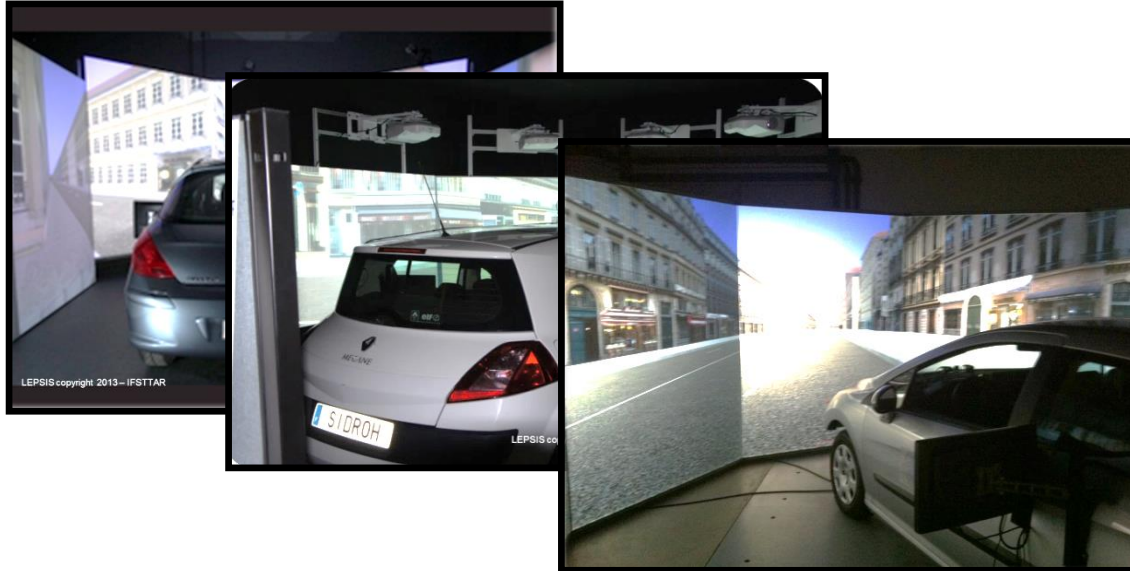
STANLEY ROBOTICS

- French startup (2015) [Stanley Robotics](https://www.stanleyrobotics.com/) just raised \$4 million (€3.6 million) from Elaia Partners, Bpifrance and Idinvest Partners.
- The company is building giant robots that pick up your car at the entrance of a parking lot and park it for you.
- A **service** is available at Charles-de Gaulle Airport since 2017
- **32 employees** hired by 2 Ifsttar researchers on autonomous vehicles (perception + automation)
- Keywords: Automation, intermodality, **public space saving**



IFSTTAR's major simulators

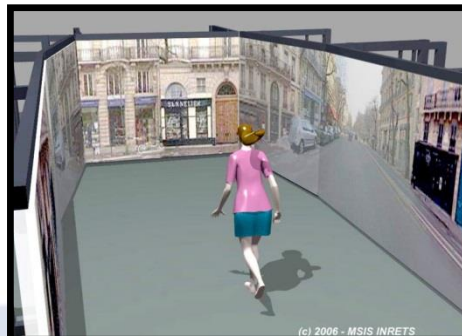
3 full-cab car simulators



Moving-base car simulator With yaw motion



2 pedestrian simulators For navigating and street crossing



Bicycle simulator



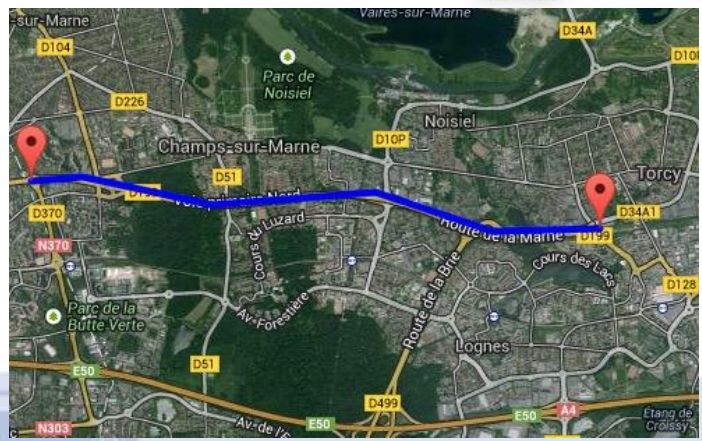
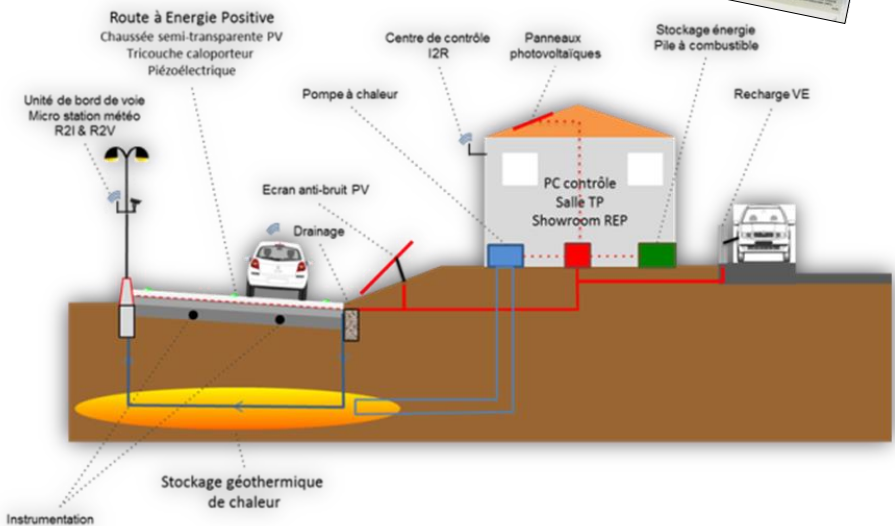
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R5G: Urban Highway A199 Regeneration



- Challenge related to the territory
 - A199 is a French motorway opened in 1974 but never finished
 - It is under-utilized but impacts negatively the neighbors
 - It has been classified as a local road in 2006 and could become an urban arteria until 2030



Project objectives: To develop a demonstrator of the fifth generation road **by innovating on the services** offered by road networks and improve the **acceptance** of these networks by neighboring people.

R5G as an innovation booster

Supported by major Research Initiatives

- **Sense-City** (9M€ funding)
- **Transpolis** (world-class fake city)
- ADEME Route du Futur : I-Street
- Infravation (EU)

Supports Real life projects (Research-Action)

- high speed railway tracks (Le Mans - Rennes)
- New ballastless tracks (Normandy)
- Urban Highways (24km around Strasbourg)
- Urban renovation (Marne La Vallée)
- Bordeaux
- ...





sense CITY

Smart technologies for sustainable cities

CSTB
le futur en construction

 **IFSTTAR**


ÉCOLE
POLYTECHNIQUE
UNIVERSITÉ PARIS-SACLAY

 **LPICM**

ESIEE
PARIS

 **cnrs**
dépasser les frontières

UNIVERSITÉ —
— PARIS-EST

 **UP
EM**
UNIVERSITÉ
PARIS-EST
MARNE-LA-VALLÉE

Inria



Bérengère Lebental, Anne Ruas,
Frédéric Bourquin, Patrice Chatellier et al.

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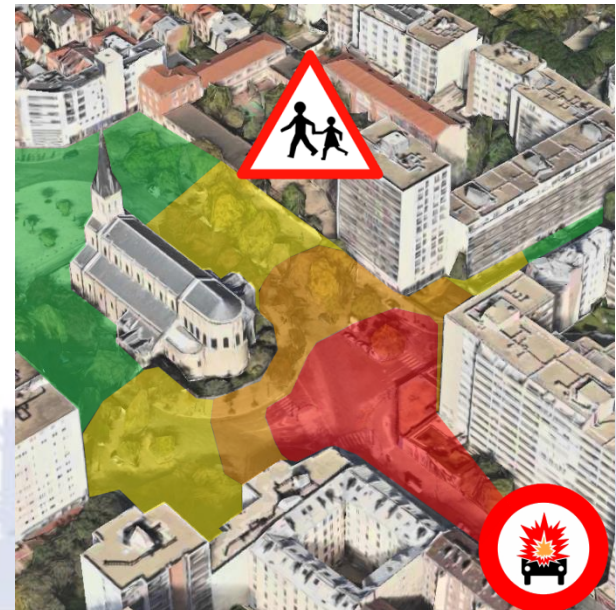
Build an internet of sensors

Measuring systems in real time, everywhere

Create sensitive environments to optimize their everyday operation

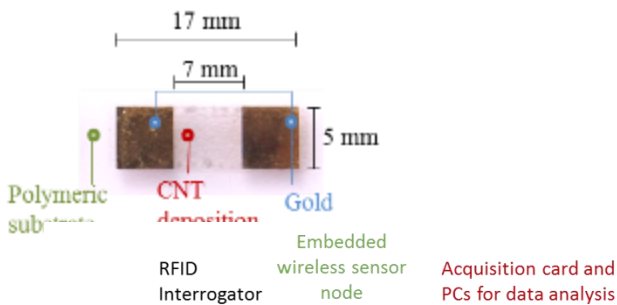
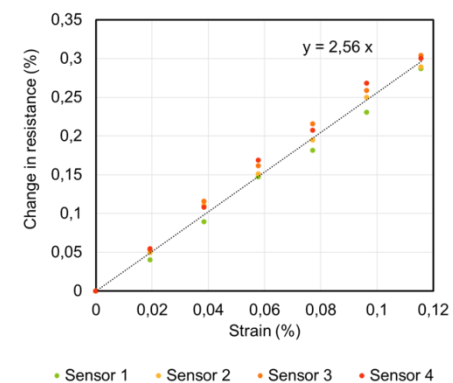
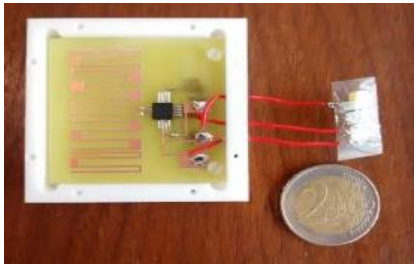
To empower decision-support tools

Throughout the value chain



Advanced nano-sensors : 2 world records, 3 start-ups

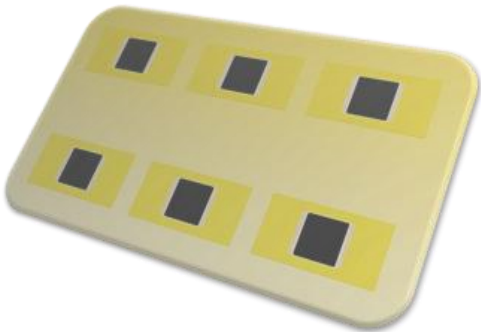
Resistive devices batch-fabricated by ink-jet printing



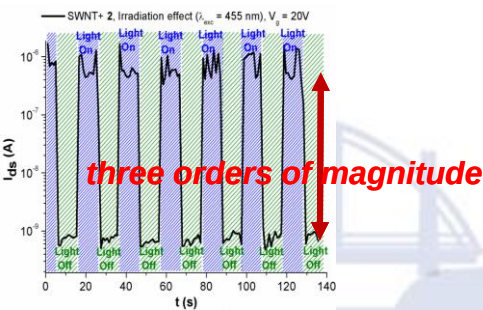
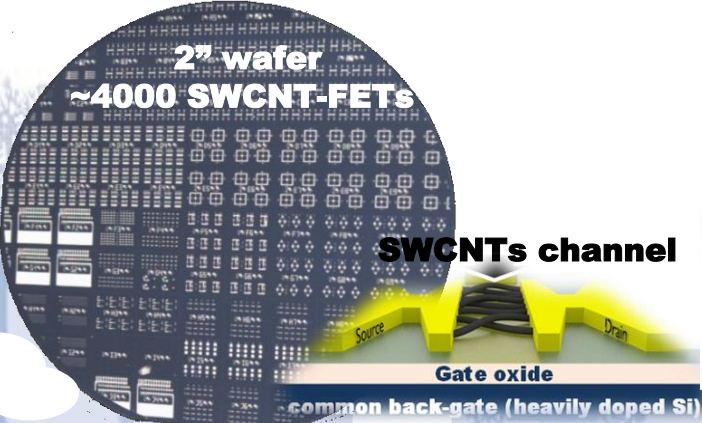
PH sensors



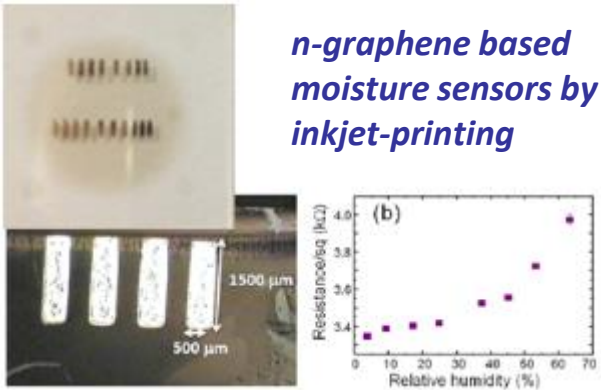
Road sensors



low noise ultimate CNT-FET transduction for gas sensors



n-graphene based moisture sensors by inkjet-printing



Sense-City en action (2018)

• **Chambre climatique**
5°/heure

• **miniville** se construit :

- système global de ville connectée
- géothermie
- réseaux d'eau
- objets enterrés à identifier depuis le sol
- matériaux bio-sourcés.

• **questions nouvelles :**

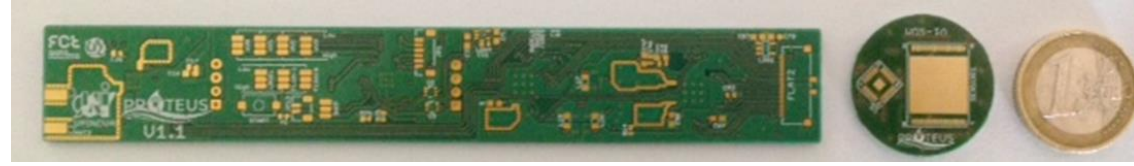
- **végétation**
- **virtualisation**
- **émissions liées au transport**
- **santé environnementale**



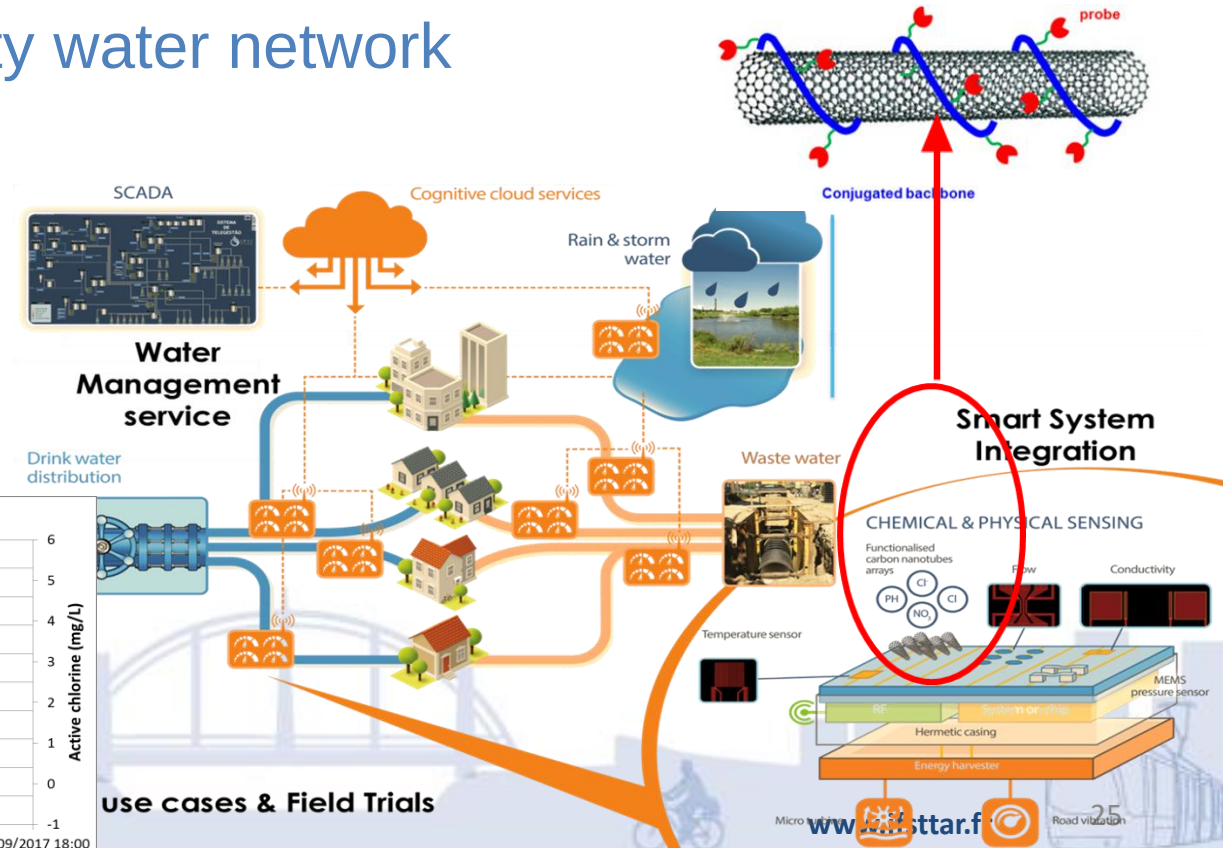


Empreinte, poids d'un véhicule : sécurisation des revenus sur chantiers en ville
 gestion du trafic,
 aide à la maintenance infra
 détection rapide de situations à risque (verglas, contresens, décalage de véhicule autonome)

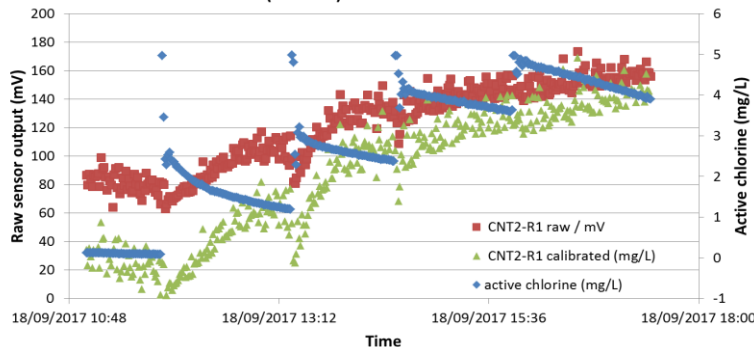
PROTEUS (H2020 Industrial Leadership), BL

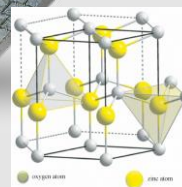
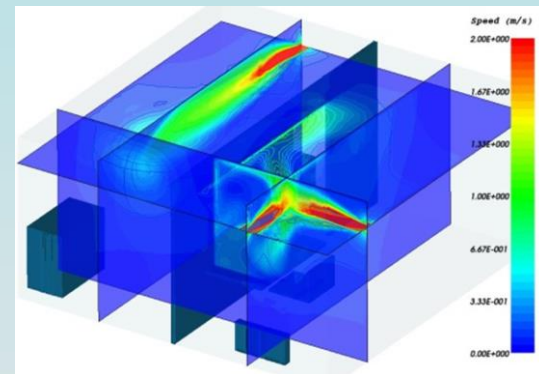
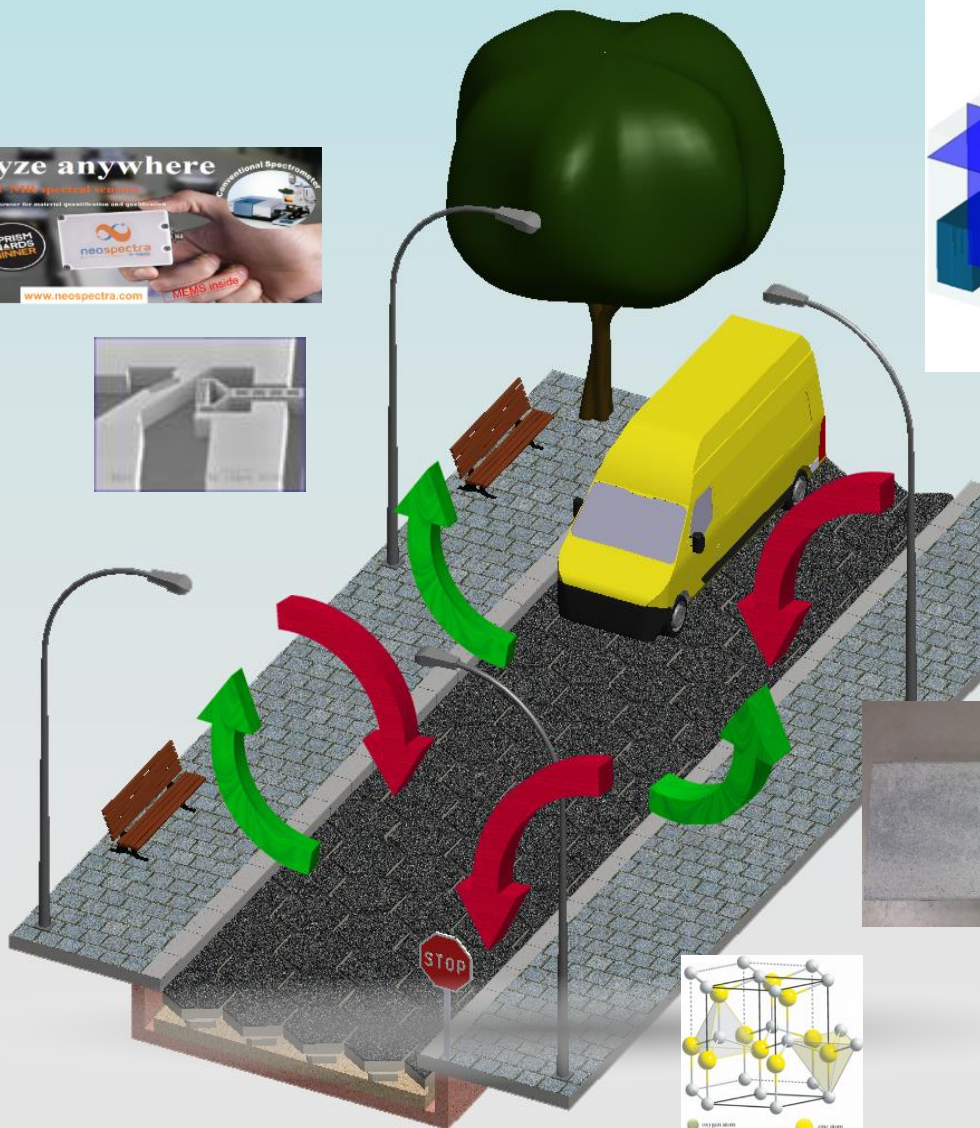


- Low cost sensor : 50x less
- pH, chlorine, ... on a single chip.
Sensitivity 10 x better than state of the art sensors.
- validation : Sense-City water network
- **start-up maturing.**



Bleach (chlorine) addition scenario





Thank you for your attention

Cooperation welcome

Ifsttar

14-20 Bld. Newton

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