FR CNRS 3539

FC LAB

Research

Towards efficient fuel cell systems

Activities in Franche-Comté Region

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femto-st SCIENCES & TECHNOLOGIES

IRTES sciences & ingénierie

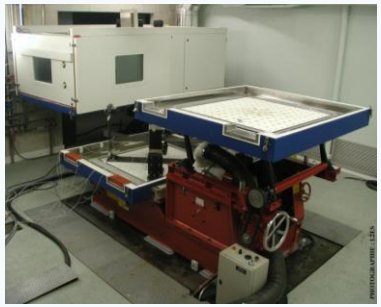
IFSTTAR COSYS/LTN

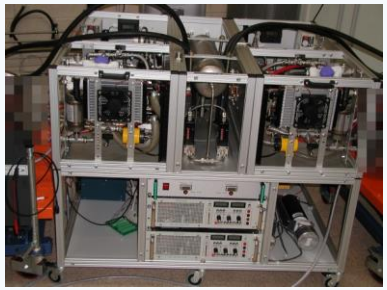
cnrs ensmm École Nationale Supérieure de Mécanique et des Microtechniques IFSTTAR UFC UNIVERSITÉ DE FRANCHE-COMTÉ utbm

www.fclab.fr

Headlines

- Regional context
- Scientific context
- Research & innovation axes
- Lighthouse projects

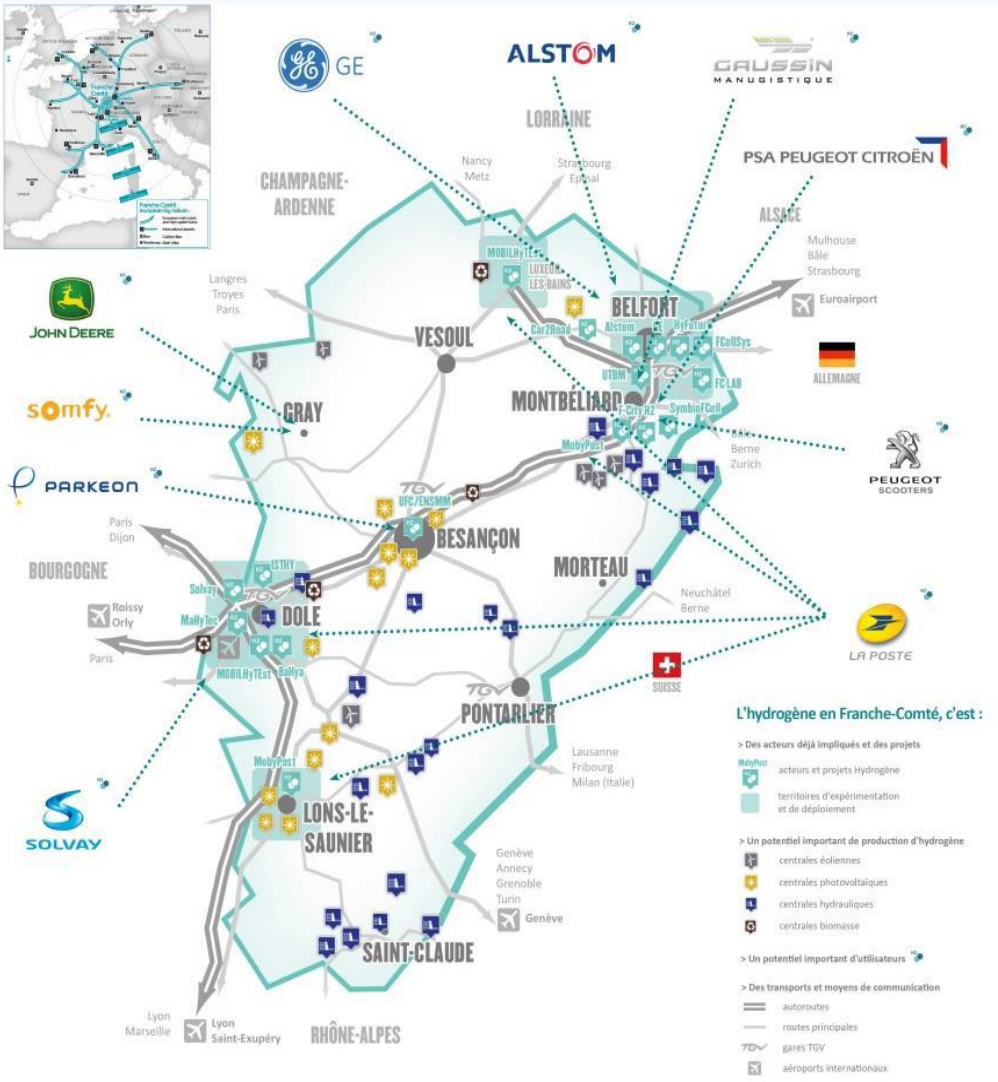




Regional context

Key features (1)

- Large industries involved in H2-energy (Solvay, GE, Alstom, La Poste, …)
- SMEs involved in H2 energy (Mahytec, Gaussin, …)
- State-of-art resident research activity (FR FCLAB, FEMTO-ST, IRTES, IFSTTAR, …)
- Clusters relating to H2-energy (Vallée de l'énergie, Pôle Véhicule du Futur, INEVA-CNRT, …)
- Strong involvement & support of local authorities (Région Franche-Comté, Dole/Belfort collectivities, …)
- Technology – demonstration territory (Mobypost EU project, Mobilhytest project, …)

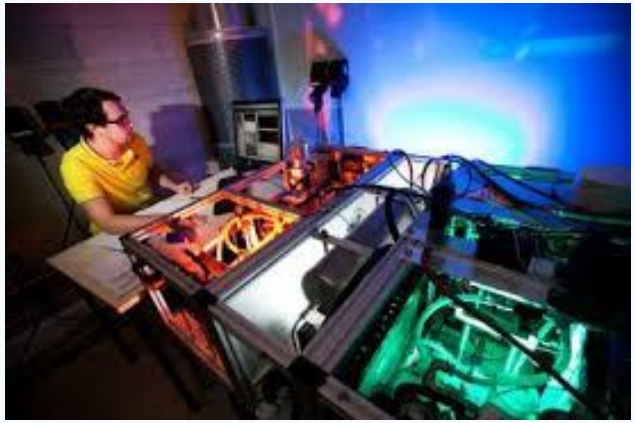


Regional context

Key features (2)

- Activities in hydrogen-energy started in 1999 in Belfort
- Nowadays :
  - Respond to remaining technological & societal bolts (e.g. efficiency, durability, hybridization, public acceptance, …)
  - Maintain our French /European leadership in research around fuel cell “systems”
  - Increase TRL level of available technologies in research labs – in line also with FCH JU2
  - Demonstration activities
    - In line with local existing industrial sector (Energy & Transport)
    - Open new common practices & new markets
  - Develop industrial activities on the territory
  - Develop university higher-level education

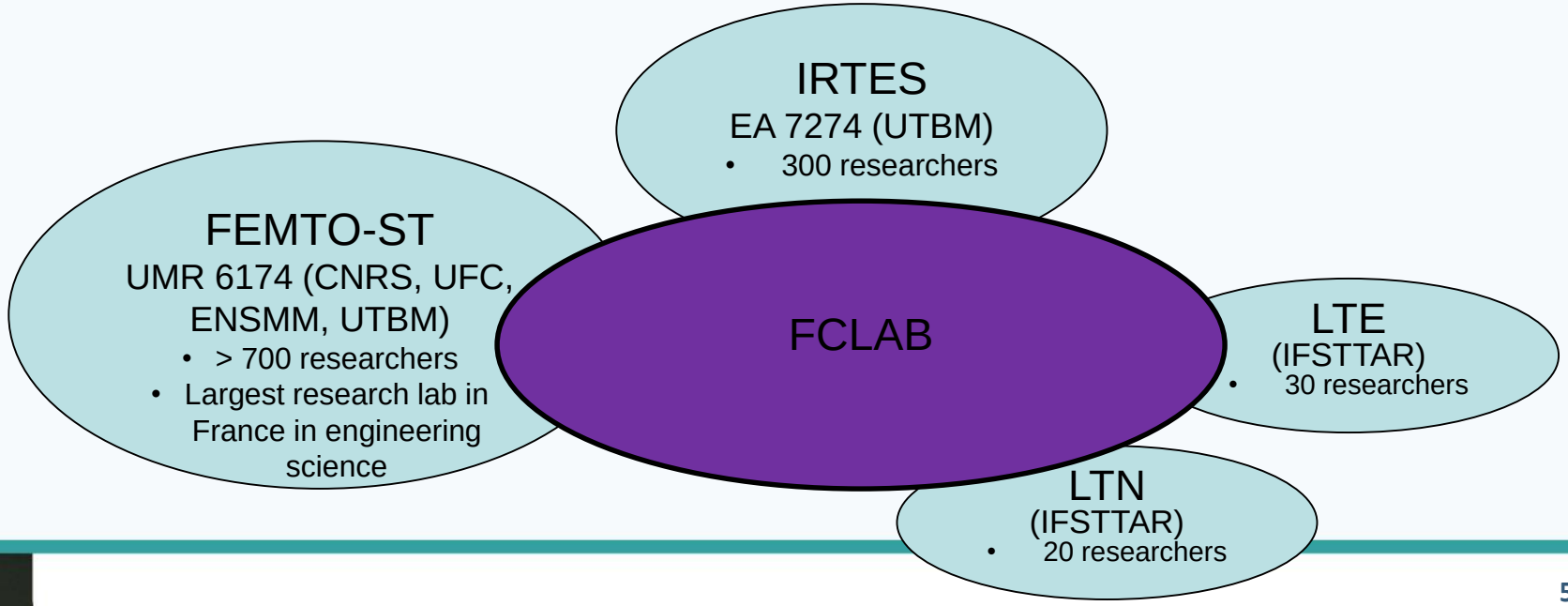
    (Univ. Franche-Comte - Hydrogen-Energy M.Eng. - CMI)



Scientific context

Key features (1)

- FR FCLAB = about **100** researchers, among them about **40** Ph.D. students
- **57** PhD thesis defended since 2004, about **60%** of French academic "production" in FC systems
- Over **5M€** annual budget (consolidated)
- **5** public organizations:
  - national-level (CNRS, IFSTTAR)
  - regional-level (ENSMM, University of Franche-Comte, UTBM)
- **4** involved laboratories (FEMTO-ST, IRTES, LTE, LTN)



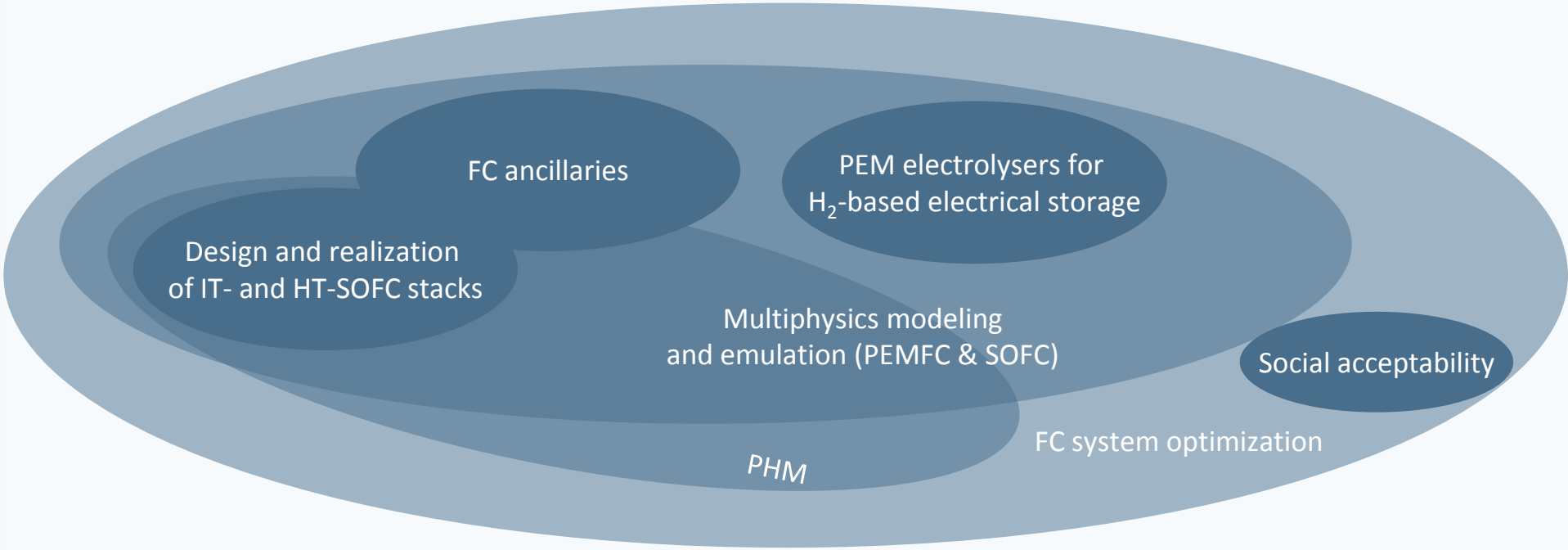
Technological context

Key features (2)

- About **1200m²** of dedicated testing areas (H2, nanoparticles, electricity, coupling to the grid) + **2000m2** of offices (for hosting up to 120 researchers)
- A single & specific unique building at UTBM campus
- **>8M€** investments in infrastructure + **>5M€** investments in test facilities
- Fuel cell test benches **from 100We to 30kWe**
- Mobile FC test benches (vehicles) up to **100kWe**
- Vibrating table + climate/temperature chambers
- **Long duration tests** (24h/7d) under actual operating conditions (electrical cycling, thermal cycling, …)

Research & innovation axes

- Complementary research issues, from FC stacks to FC systems (including environment)
- Application fields : transport & energy
- Scientific and technological themes in line with industrial requirements



Headlines

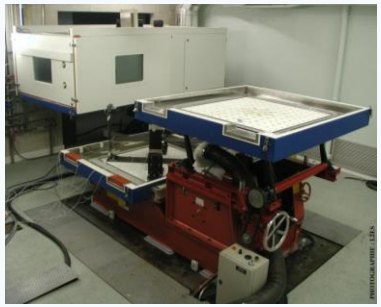
Lighthouse projects

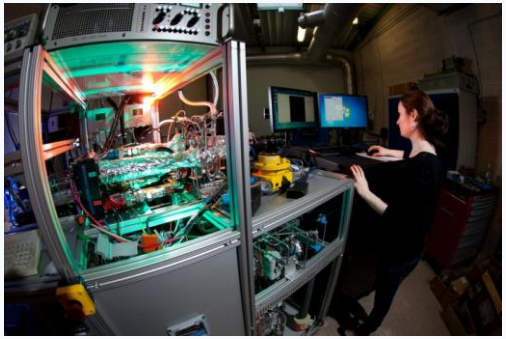
in Franche-Comte Region

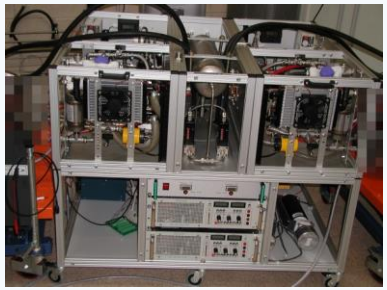
in last years

…

A flavor…







Lighthouse projects (1)

H2 energy storage

- High pressure storage and metal hydride systems
- Spin-off from FEMTO-ST/UFC (2008)
- 2014 : 18 peoples
- Turnover = +45% between 2012 & 2013
- Winner, World Innovation Competition 2014

Metal Hydride Tank

Bahya H2 lawnmower(city of Dole - 2010)

H2/FC mini-bar (coffee maker)
(SBB - 2014)

Lighthouse projects (2)

F-City H2 vehicle

- Urban electrical vehicle
- Presented 2011
- Replacement of batteries by a FC system
- Autonomy x2 , ratio autonomy/weight x3,6
- First FC vehicle registered in France

Ministère de l'Intérieur

Numéro d'ordre du certificat 10039353234

Certificat Provisoire d'Immatriculation

Autorise, pendant sa période de validité, la circulation du véhicule sur le territoire national dans l'attente, le cas échéant, du certificat d'immatriculation (Article R.322-3 du code de la route).

(A) Numéro d'immatriculation: BZ-102-BZ

(I)Date du CPI: 15/12/2011

(B) Date de 1ère immatriculation: 15/12/2011

(H) PERIODE DE VALIDITE du 15/12/2011 au 14/01/2012 INCLUS

(C.1) FAM AUTOMOBILES
353728231
115 ALLEE HUGONIOT
25460 ETUPES

FAM AUTOMOBILES

AGG000

F-CITYH2

VS2AGG000BA000001

1140

1140

765

690

L7e

QM

QLOM M

0000

H2

8

2

Pour le ministre de l'Intérieur et par délégation,
La sous directrice de la circulation et de la sécurité routières

A. Lebrun

Anne Lebrun

288 €
6 €
2.5 €
34 €
4 €
328.5 €

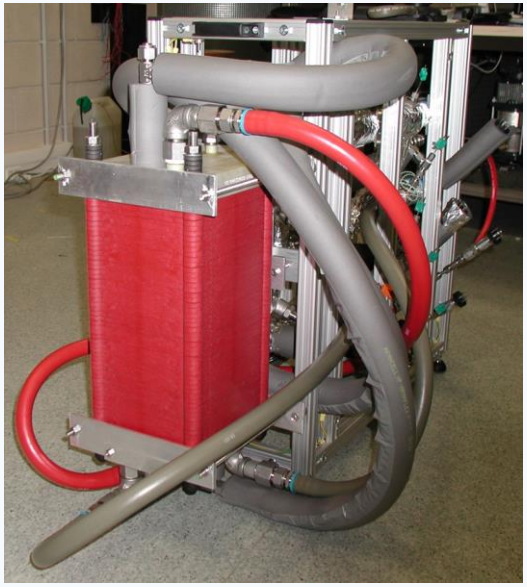
Le CPI ne permet pas la réimmatriculation du véhicule en France ou à l'étranger
The PRC does not allow re-registration of the vehicle in France or abroad

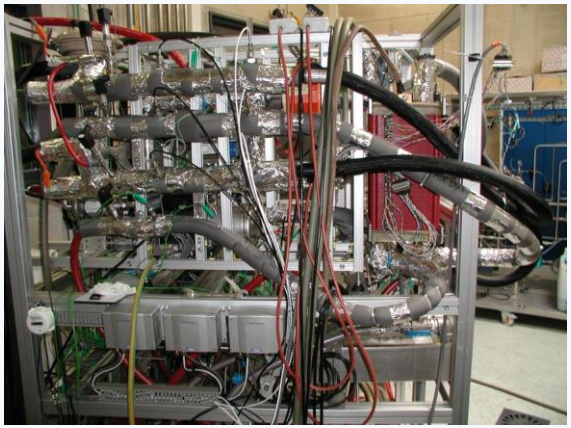
Lighthouse projects (3)

FC on aircraft – CELINA EU Project

AIRBUS
AN EADS COMPANY

- Identification of FC needs for aircraft design
- Investigation of the technical capabilities of an existing fuel cell system under aircraft operating conditions
- Generation of aircraft integration strategies and simulation within the aircraft environment
- Project 2005-2008





Lighthouse projects (4)

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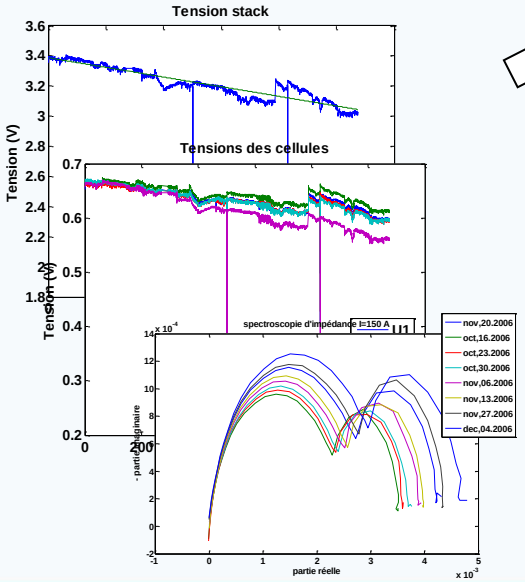
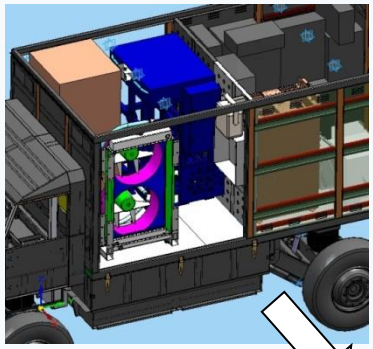
Heavy-Duty (military) FC vehicle – FR ECCE project

- Program completed 2012
- Objectives:
  - Durability issues of PEM fuel cell systems in transportation environment
  - Multiphysical modeling (EMR formalism approach)
  - Integration of a high-power PEM fuel cell system on a (military) heavy-duty vehicle (15 tons)
  - Optimization of energy flows (type-2 fuzzy logic control)





Lighthouse projects (5)

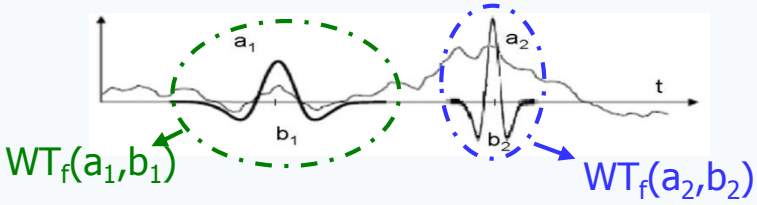
Mobypost project – EU project

- Years 2011→2015
- Objectives:
  - Design an optimized hybrid FC powertrain
  - Energy flow supervision
  - Coupling with renewables (PV panels)
  - Hydrogen production & storage on-site
  - 1st French FCV fleet testing in constrained environment (temperature, power demand)

Lighthouse projects (6)

FC Power Units Diagnostic – EU FCH projects / FR ANR projects

- Years 2007 → 2014
- Objectives:
  - Increase durability of fuel cell systems
  - On-line diagnosis of FC stacks and systems using a minimum number of actual sensors

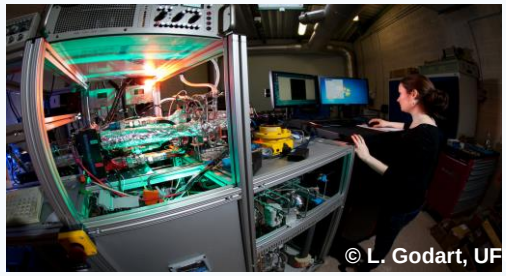


World patents issued !

FC Power Units Prognostic

EU FCH projects / FR ANR projects / ADEME project / FC Regional Council projects

- Years 2012 → 20..
- Objectives:
  - Develop approaches for reliable prognostics of PEMFC systems
  - Strong link with warranty / maintenance proposed on FCS
  - Total funding – (ongoing) > 3.0M€



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FC LAB

Research

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