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HYDROGEN ENERGY

—
in BOURGOGNE
FRANCHE-COMTÉ

BOURGOGNE-FRANCHE-COMTÉ, THE HYDROGEN ECONOMY DEMONSTRATED

INTRODUCTION

The Hydrogen vector of energy transition is also a lever for territorial development: the deployment of demonstrators and experiments favours the structuring of actors while contributing to increasing the energy independence of territories.

SUMMARY

Bourgogne-Franche-Comté, Hydrogen territory	p.04
ENRgHy	p.10
Projects	p.11
Coordinated ecosystem	p.14
Pioneering territories	p.15
Innovative companies	p.17
Research and innovation details	p.19
New training	p.22
A favourable environment	p.24
Accompanying development	p.26



**La Bourgogne-Franche-Comté,
naturally european**

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HYDROGEN IS A SOLUTION FOR EVERYONE. HYDROGEN CEASED LONG AGO TO BE A SOLUTION ONLY FOR ROCKETS! IT IS WELL ON THE WAY TO BECOMING A VERY COMMON SOLUTION. WHEN MAHYTEC WAS LAUNCHED IN 2008, IT WAS NOT THOUGHT THAT THE FIRST PUBLIC APPLICATIONS OF HYDROGEN WOULD BE TO MAKE COFFEE!

”

Dominique PERREUX,
Co-founder of the company

BOURGOGNE-FRANCHE-COMTÉ, HYDROGEN TERRITORY...

HYDROGEN IS CONFIRMING ITS PLACE AMONG THE ENERGY SOLUTIONS OF THE FUTURE

2016, a new acceleration towards industrial deployment was set in motion. Around the world, competition is fierce and it is today that pride of place will be won.

Worldwide, private investors unite to finance prototypes and innovative companies issuing from public research. The 2020 Tokyo Olympic village will function entirely from hydrogen. Vehicle fleets are expanding and recharging stations are being deployed. **In 2030 the Hydrogen vehicle market may represent nearly 800,000 vehicles and 600 stations³.** The coordinated development of vehicles and recharging stations will allow a rapid transition from experiments to widespread actual use.

Air planes are testing Hydrogen systems in order to reduce their fuel consumption and Hydrogen boats will soon be launched in a world tour.

The world of Hydrogen is buzzing!

2017, the «Hydrogen Council» was launched at the World Economic Forum at Davos. It united 13 large groups of energy sectors, transport and industry which thus showed their willingness to unite their forces to promote, develop and spread the use of Hydrogen as an essential vector in the worldwide energy future, to invest in this sector 10 billion euros in 5 years. Among them will be the French Air Liquide, Alstom, Engie and Total.

France is classed 6th worldwide in terms of scientific production linked to Hydrogen.

BOURGOGNE-FRANCHE-COMTÉ, A RESERVOIR OF SOLUTIONS TO MEET THE CHALLENGES OF THE ENERGY TRANSITION

Involved in national and European technology projects, **Bourgogne-Franche-Comté is positioned, with FCLab, since 2005, as an expert actor in the integration of battery systems and combustibles for transport applications.** It is also known for its research approach linked to modelling, experimentation and the optimisation of combustible battery systems and produces 60% of academic research publications in France. Inclusive, energies concentrate today on **demonstrating models which are economic, efficient, durable and viable of complete systems of production, storage and distribution of Hydrogen energy coupled with renewable energies** mobilised in order to be very rapidly in the first ranks of Hydrogen territories.

CLASSES²

1st industrial region in France
with 17.3% of industrial employees of the total workforce
for the part of industrial added value in total added value

1st region for surface treatment
For the part of workers in the speciality of total workers

1st region for cutting-stamping
with 20% of French companies in this speciality

2nd region for the manufacture of technical plastics parts with 9% of French companies in this speciality

1st importing region in France
with 122% of the amount of import/export

3rd best commercial balance in France in 2016

HYDROGEN DYNAMIC, IN BOURGOGNE-FRANCHE-COMTÉ

1998

1st "combustible battery and Hydrogen tanks" research project By the University of Franche-Comté

2002

Launch at Belfort of the cluster CNRT - Inéva of the 1st French research platform dedicated to the combustible battery system

2006

1st trial of 80 kWe PAC on railway engine

2009

Equipment of heavy vehicle ECCE* with the combustible battery the most powerful installed in France in a transport application

* Evaluation of components of an Electric Chain

2012

1st lawnmower functioning on Hydrogen inaugurated by the Grand Dole

2015

- Launch of the regional industrial hydrogen strategy
- Creation of 1st COURSE OF MASTER IN ENGINEERING (CMI) : Hydrogen - Energy and Energy Efficiency, UNIQUE IN FRANCE

1st research activities into Hydrogen - combustible battery energy

1999

Creation of Centre of Competitiveness of the Future and inclusion of the strategic H2 approach

2005

MAHYTEC begins its activities

2008

1st licensing in France of a car fuelled by Hydrogen registered in France F-City H2

2011

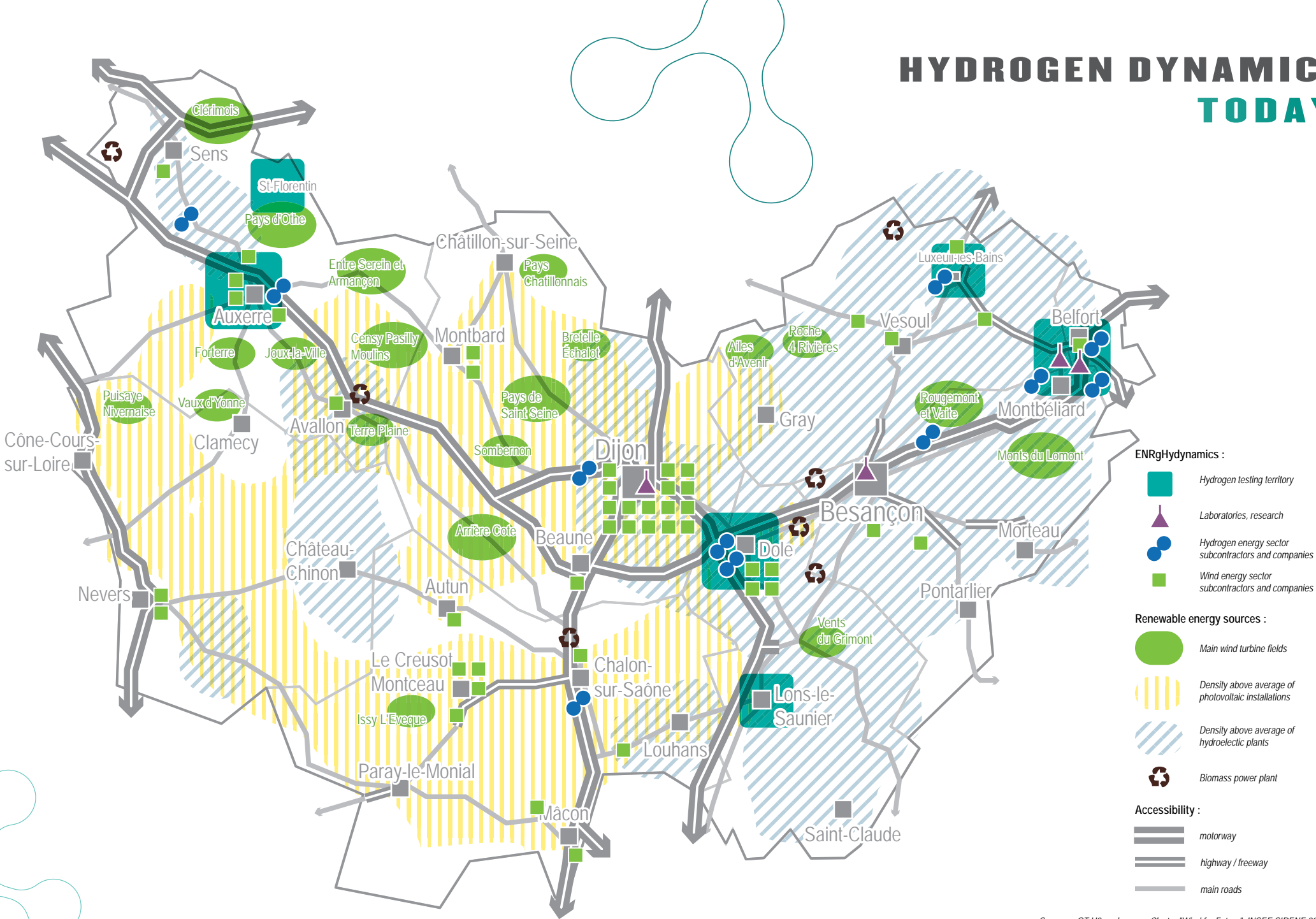
- Design of a hydrogen mini-motorcycle for the competition Eco-Challenge Proto-IUT Mechanical Engineering and Production Theory Department France
- 1st experiments "Mobypost" at Perrigny (39) and Audincourt (25) and "MobilHyTest"» at Dole (39) and Luxeuil-les-Bains (70)

2014

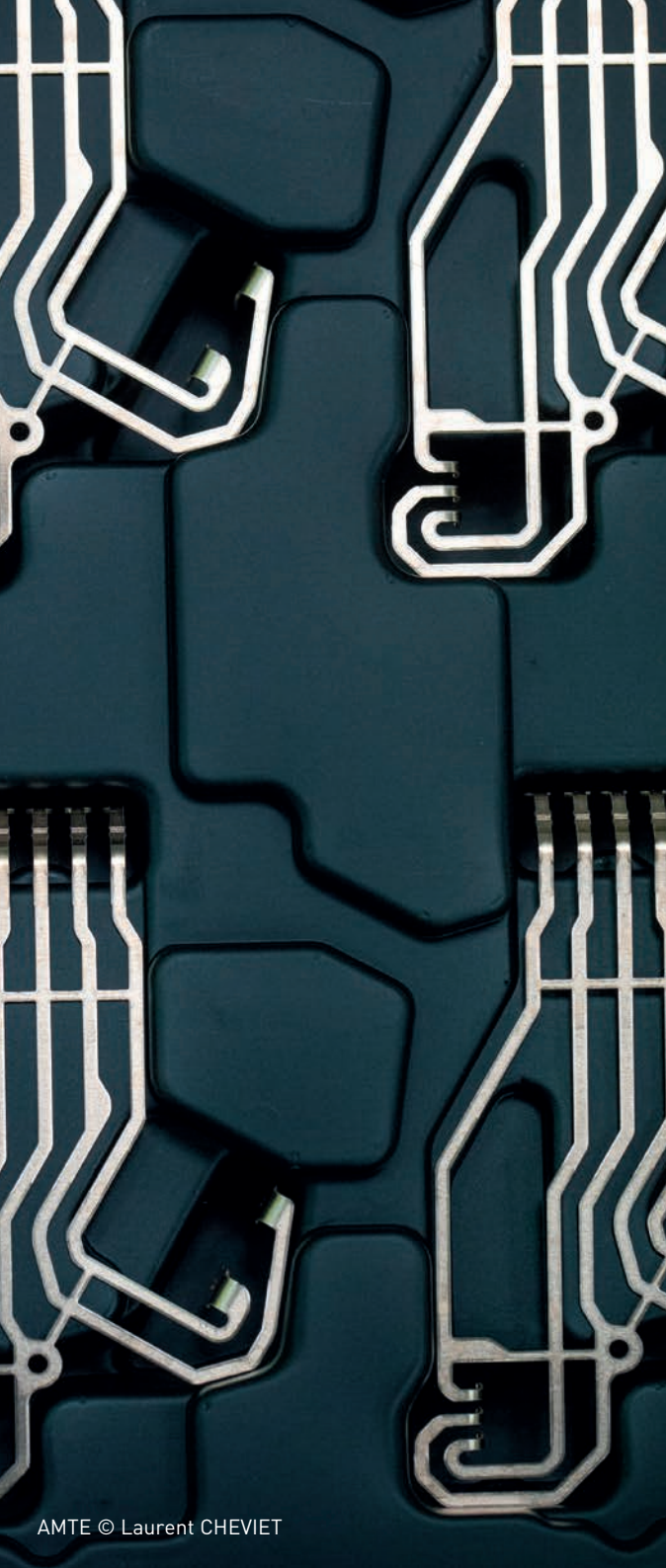
- 1st stationary Hydrogen electric generator
- La Bourgogne - Franche - Comté becomes Hydrogen Territory

2016

HYDROGEN DYNAMIC, TODAY



Sources : GT H2 work-group, Cluster "Wind for Future", INSEE SIRENE 2017
Mapping : ARD Franche-Comté - April 2017



A TERRITORY OF INDUSTRIAL ENERGIES...

With 47,800 km², Bourgogne-Franche-Comté is the 1st industrial region in France. It has the unusual characteristic of being at the same time one of the most industrial regions in France and with nature preserved. Only 4% of its area is developed⁵.

It is in this environment that two industries have developed that form the crucible of current Hydrogen Technology developments.

First, the car and railway industry, which is underpinned by expertise in metallurgy, has favoured the building of an industrial fabric which is particularly dense in sub-contracting companies. The know-how of these companies enables them to respond to the totality of mechanical and micro technical needs, from plastics processing to composite materials...

Next, **the energy production equipment industry.** The leaders of the sector are established, here, attracted by the the proximity of all these skills.

... INNOVATIVE EXPERTISE: THE RESEARCH AND INDUSTRY ALLIANCE

Energy and transport have thus become the speciality of a whole territory!

Today, the ecosystem around Hydrogen technologies is being built up. Research organisations provide responses not only for the integration of combustible battery systems but also for the development of techniques for the production of clean and economically viable Hydrogen. Solutions to optimise the yield of electrolysers and Hydrogen storage systems are in the process of development in the laboratories of Bourgogne-Franche-Comté. Research is now a powerhouse which engenders start-ups which enrich the ecosystem around Hydrogen.

hydrogene.ardfc.org



“

**OUR AMBITION IS TO PURSUE STRUCTURING
INNOVATION, INDUSTRIALISATION,
TRAINING AND STIMULATION OF THIS
DOMAIN IN ORDER TO PRODUCE A CUTTING-
EDGE DOMAIN AT THE NATIONAL LEVEL AND
BEYOND.**

”



Marie-Guite DUFAY,
President of the Bourgogne-Franche-Comté regional council

ENRgHy...

“

OUR TERRITORY CONCENTRATES SEVERAL MAJOR ACTORS WORKING ON HYDROGEN. OUR OBJECTIVE IS TO BECOME A STRONG LINK IN THE DOMAIN, NOTABLY FOR PROBLEMS OF STORAGE AND SYSTEMS APPROVAL.

”

Claire BOURGEOIS-RÉPUBLIQUE,
Vice-Chair responsible for economic affairs (Grand Dole)

© ARDFC-YDU

ENRgHy, THE HYDROGEN ECONOMY DEMONSTRATED

A Hydrogen territory is a territory which has decided to develop a concrete economy around Hydrogen, an energy vector shown to be one of the future solutions. **ENRgHy is the response of Bourgogne-Franche-Comté** in calling for projects for “**Hydrogen Territory**» launched by the Minister for the Environment for Energy and the Sea in May 2016 and whose objective was to label projects of large-scale demonstration implementing the Hydrogen energy vector in the territories.

ENRgHy is the first step in the roadmap of a regional Engagement, coordinated by the regional council, measured and considered on the emergence of a Hydrogen energy domain in the territory of Bourgogne-Franche-Comté within the context of energy transition. The deployment of this domain figures among the strategic orientation of the Region in complement to the actions as regards energy efficiency and the development of renewable energies.

ENRgHy relies on a fertile and pioneering university base. A little less than 20 years ago, at Belfort, the first work on combustible battery systems began. Since then, FCLAB, the technology platform unique

in France has doubled its experimental capacity and assembled 150 researchers.

ENRgHy is also the dynamic involvement of the regional industrial fabric supported by territorial authorities and institutions. Accompanied by the Pôle Véhicule du Futur, the cluster Wind For Future, l'Université de Technologie de Belfort-Montbéliard and l'Agence Régionale de Développement, among others, they are creating a diverse and robust ecosystem.

ENRgHy has the ambition to be the proof of the creation of knowledge, economic value and employment by bringing about energy transition and participation in the regional spread of clean and renewable energy in society. Specifically, the Region supports the deployment of the Hydrogen energy domain with 6M€ included in the 2017 budget. ENRgHy will enable financing 7 projects involving 3 territories... to start with...



ENRgHy : 7 PROJECTS, 3 TERRITORIES, 0 EMISSION

Historically based at Belfort, the development of experiments on Hydrogen energy have spread throughout the region. While the urban area of Belfort-Montbéliard is consolidating its global place with laboratories which test the integration of combustible battery stems, at **Dole**, industrial and institutional interests aim to demonstrate the efficacy of an industrial domain based on the Hydrogen economy. In l'**Yonne**, there is a double objective. This means, on one hand, to couple the sources of renewable energy - methanisation and wind - and Hydrogen on the other hand to supply the urban bus network with the Hydrogen vector regulated by smart grids.

2 STRUCTURING EQUIPMENT FOR THE NATIONAL DOMAIN

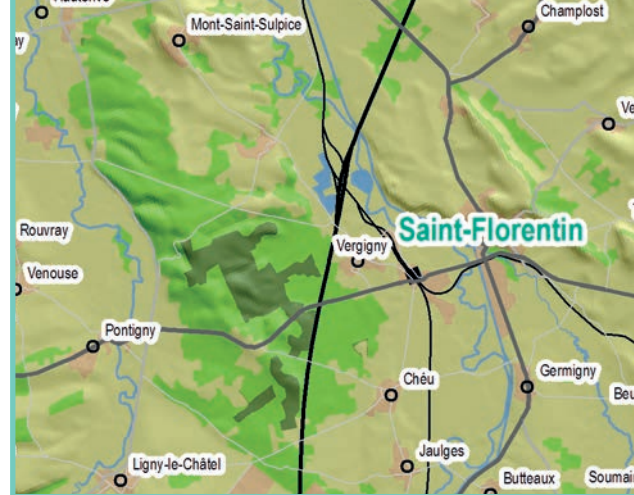
Parallel to setting up experiments, the Region is investing to **create favourable conditions for the deployment of technologies linked to Hydrogen**. Through projects structuring the ambition to help industries to migrate towards the Hydrogen economy.

DOLE : **ISTHY**, THE NATIONAL PLATFORM FOR HYDROGEN STORAGE

A unique institute to test and qualify Hydrogen storage apparatus. Supported by le Grand Dole the project created by USTHTY unites industries (PME and large groups), organisms and agencies acting in the domain of Hydrogen and the authorities. It has as its objective to **become the centre in France of certification and re qualification of storage systems and to be at the centre of training and R&D** enabling anticipation of technological developments

AIRE URBAINE BELFORT-MONTÉBLIARD : **HYBAN**, A TEST BENCH OF GREAT POWER

An industrial test bench, of very powerful combustible batteries, PEMFC and HT PEMFC type, (100-120 kWe) unique and indispensable for marketing "full fuel Cell power" vehicles will complete the equipment of the Combustible Battery platform at Belfort.



AUXERRE : EOLBUS, A PILOT PROJECT IN FRANCE COUPLING WIND AND TRANSPORT

Demonstrate economically that it is possible to move to a “0 emission” transport system based on Hydrogen and ENR.

A PROJECT

The project is carried by the Auxerre conurbation with the support of the cluster WindForFuture in relation with le Pôle Véhicule du Futur and involving nearly ten industrial partners. It aims to create a production, storage and distribution station, supplied by wind generators to provide the urban bus network and light vehicles in the Auxerre conurbation.

A DEMONSTRATION

For a period of 2 years, it intends to demonstrate:

- the pertinence of storage solutions of electricity sources which are intermittent: of the production of Hydrogen by a wind farm and its regulation by a smart grid according to the network charge,
- the potential of a new economic model via experimenting on a large scale with the deployment of the energy transition.

SAINT-FLORENTIN : HYCAUNAIS, THE FIRST PROJECT COUPLING METHANISATION AND METHANATION

Demonstrate the potential for the future of “power gas” technology and launch a new industrial domain.

A PROJECT

This project, a real circular economy “waste to energy” initiative, proposes to value the CO₂ present in the Saint-Florentin landfill site by using the procedure of methanation. The Hydrogen necessary for this procedure is itself supplied by wind production.

A DEMONSTRATION

Over a period of 6 years, the objective is to contribute to energy transition by demonstrating the possibilities of replication for:

- large scale energy storage in the gas network for the development of intermittent ENR,
- regulation and optimisation, by use, of the smart grids
- the elimination of CO₂ before emission into the atmosphere.

DOLE : NEWMHYLL, HYDROELECTRICITY AND HYDROGEN

Demonstrate the feasibility of an economic model for the future of small scale hydroelectricity using Hydrogen.

A PROJECT

The project should enable testing the economic viability of autonomous solutions based on low pressure Hydrogen. This project is original in that it consists of developing “zero emissions” tourist services providing transport solutions which are soft, urban and for the river.

A DEMONSTRATION

For a period of 3 years, it intends to demonstrate:

- the viability of small production units associated with local use,
- to convince the public of the safe use of Hydrogen.



GRAND DOLE CONURBATION : **VHYCTOR** - DISTRIBUTION STATION FOR HYDROGEN PRODUCED AT INOVYN

Demonstrate the likelihood of drastic cost reduction Distributed in stations of a new concept

A PROJECT

The concept rests on the construction of a Hydrogen distribution station supplied by an industrial gas source co-produced and transported at high pressure. The development of a nationally duplicable chain of transport enabling the rapid implementation of a distribution network which is structured and competitive on the national territory.

A DEMONSTRATION

Over a period of 2 years for the construction and 1 year of experiments, VhyTor aims to reduce costs in relation to existing solutions by using a massive source of Hydrogen; transport at high pressure and distribution via simplified stations.



AIRE URBAINE BELFORT-MONTBÉLIARD : **HYDATA**, STATIONARY HYDROGEN ENERGY DOUBLE EFFECT FOR A DATA CENTRE

Demonstrate gains and inputs of an autonomous production/ consumption stationary Hydrogen energy solution.

A PROJECT

The size of the digital universe doubles every 4 years, data centres which accommodate treatment services, storage, restoring billions of Gigabytes of data created each day are trying to reduce their energy consumption and improve their availability.

Electricity supply via an autonomous Hydrogen system issuing from renewable energies and installing a of a backup application appears to be an interesting optimisation solution.

A DEMONSTRATION

Over a period of 2 years, HyDATA will enable the validation of pertinence of a stationary fuel supply application:

- intelligent management in real time of renewable input - production/consumption,
- optimised regulation of heat emitted,
- specific low pressure-high density Hydrogen storage.



LA BOURGOGNE-FRANCHE-COMTÉ, LABELLED HYDROGEN TERRITORY, IS ACCUMULATING THE ASSETS: A CUTTING EDGE RESEARCH CENTRE, LEADING GROUPS, THE PME AND YOUNG COMPANIES AT THE ORIGIN OF INNOVATIONS, ACTIVE COMPETITIVENESS CLUSTERS AND TERRITORIAL AUTHORITIES INVOLVED IN HYDROGEN ENERGY AND TRANSPORT. A DYNAMIC, WHICH HAS AS ITS BASE SKILLS AND TECHNOLOGIES IN THE PROCESS OF INDUSTRIALISATION AND WHICH WILL BENEFIT FROM ACTORS WHO HAVE PARTICIPATED, HERE, IN THE DEPLOYMENT OF A BROAD SPECTRUM INDUSTRIAL DOMAIN.

A COORDINATED ECOSYSTEM...

“

THE HYDROGEN SECTOR IN BOURGOGNE-FRANCHE-COMTÉ AND THE PROJECT ENRgHy: ONE OF THE FINEST OPPORTUNITIES FOR INNOVATION AND FOR DEMONSTRATING ITS VIABILITY ON A LARGE SCALE AND MULTI USE OF THE HYDROGEN ENERGY VECTOR AND PARTICIPATION IN THE STRUCTURE OF ENERGY TRANSITION.

”

Frédérique COLAS,
Vice-Chair of the regional council, responsible for ecological transition and environment

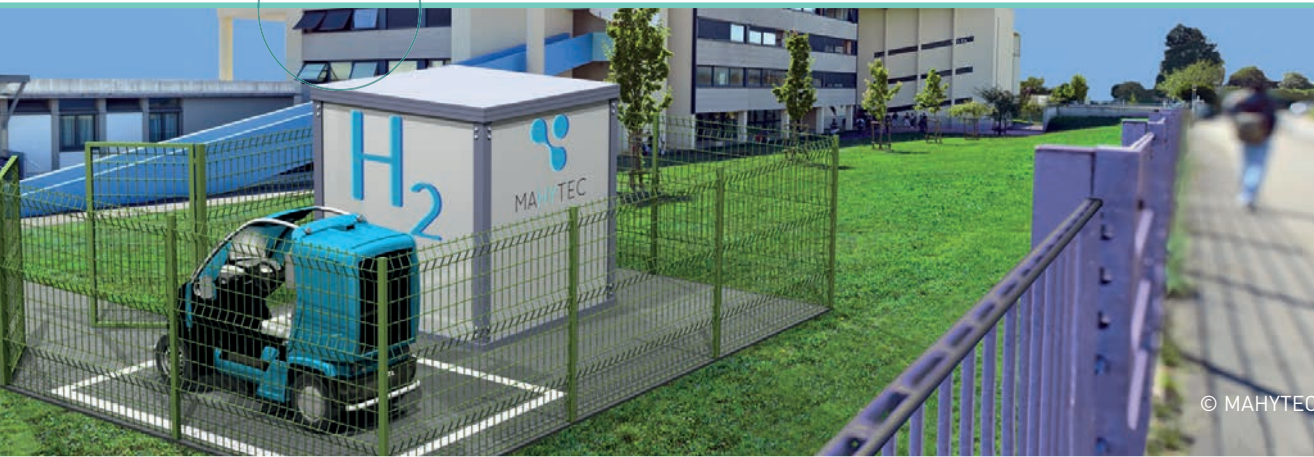
© ARDFC - M60

THE PIONEERING TERRITORIES AND THE CONURBATIONS INVOLVED

Initiated at Belfort at the end of the XXth century, the Hydrogen adventure has since developed throughout the territory thanks to the engagement and support of territorial authorities.

The first work on combustible battery systems began in FCLAB, the 1st research federation on the theme of Hydrogen created in 1999. Proof that the development of its activities was needed, it has doubled its capacity in 2013. Today, 60% of the documentary production of academic French research issues from Bourgogne-Franche-Comté.

Since 2004, the **Dole conurbation** has been engaged in a reflection to favour a new technology which has driven it to become a territory of experimentation notably with the projects HYDOLE, MOBILHYTEST and BAHYA. **In the Doubs and the Jura**, it is the MOBYPOST which are tested by the group La Poste: the postmen of **Audincourt** and **Perrigny** use Hydrogen vehicles and the stations use solar energy for electrolysis. While at **Dole** and **Luxeuil-les-Bains**, they have tested H2 range extender electric vehicles within the context of the MobiHytest programme. The fusion of the Bourgogne and Franche-Comté regions has favoured the merger with **l'Yonne**, about to become the first wind energy department in the region. Wind and Hydrogen are going to enable Auxerre to put into circulation Hydrogen buses.



FIRST IN FRANCE

In order to prepare for the future, the education of the younger generation is of capital importance. The Conseil régional de Bourgogne-Franche-Comté has promoted a programme to establish a complete Hydrogen energy solution, not only for energy storage but also for transport, in 5 lycées. The company MAHYTEC has responded by associating other companies and regional skills to propose a turnkey solution consisting of a dual function station which allows storage of electrical energy and restoring it using a “combustible battery and batteries” system. This station will also supply Hydrogen to a vehicle. This is a Hydrogen quadricycle enabling the transport of a very useful charge. Together these will enable at the same time teaching activities for students and new features for lycées.

With such a system, high school students will have complete knowledge at scale 1 of Hydrogen energy technologies for the lycées of the 21st century.

© MAHYTEC

MORE THAN 50,000 KMS DRIVEN BY HYDROGEN VEHICLES IN BOURGOGNE-FRANCHE-COMTÉ



© Groupe La Poste

Since 2014, 10 MobyPost vehicles and 2 recharging stations have been used by Post Office personnel: a complete system of carbon free transport using combustible battery electric

vehicles supplied by renewable Hydrogen produced locally. The electricity needed for the production and daily distribution of Hydrogen is generated by photovoltaic panels. In 2014 also Kangoo type vehicles with “range extender H2” which delivered the packages for the Post Office at Luxeuil-les-Bains [70] and Dole [39].

INVESTMENT FOR A HYDROGEN DISTRIBUTION STATION



© Solvay

Predicted in the project VHycTor, this station may be in service from 2018. The objective is to value co-produced Hydrogen from the the site INOVYN in Tavaux and its distribution in distribution stations for vehicles.



INNOVATIVE COMPANIES

MAHYTEC, 250 STORAGE TANKS INSTALLED IN THE WORLD



The only company in Europe to design and produce 2 types of storage technology for Hydrogen for mobile, nomad or stationary applications: a high pressure system and a hydride system storing Hydrogen in solid form at low pressure.

Mastering the entirety of the Hydrogen chain: the key solution ... SECURITHY, developed by MAHYTEC, is composed of an electrolyser, a storage reservoir at 30 bar, a combustible battery and batteries which enable it to supply electricity in all

conditions. MAHYTEC associating other regional skills with its Hydrogen expertise will establish 5 dual use hybrid "combustible battery and battery" stations and to fuel hydrogen vehicles also provided. These clusters set up in 5 lycées in Bourgogne Franche-Comté, have as their objective notably to raise awareness in the new generation of the potential of renewable Hydrogen energy in the context of energy transition.

www.mahytec.com

H2SYS, SILENT, NON POLLUTING, AND NO MAINTENANCE ELECTRICAL GENERATORS



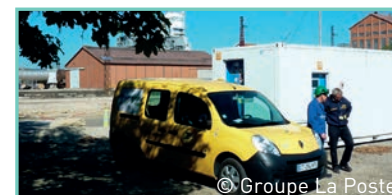
H2SYS is developing and commercialising hybrid electric generators, fuelled by hydrogen, for power from 1kW to 20 kW. The start-up is supported by results from several years of applied research conducted at the research federation FCLAB CNRS at Belfort, and values research work in innovative solutions, responding to the environmental challenges of the 21st century.

These new electrical generators, silent and "0 emission" can be used inside buildings, ensuring safe power supply replacing emergency generators and even

supplying electric power at work sites or isolated sites. The field of application of the generators is broad enough and thanks to Hydrogen energy, the start-up is in the service of industrial development and energy transition.

www.h2sys.fr

INOVYN



© Groupe La Poste

With more than 10,000 tonnes per year, Inovyn is the first producer in France of low carbon co-produced Hydrogen. The company is cooperating in the success of the project VHycTor.



INNOVATIVE COMPANIES

SCHRADER, SAFETY VALVES FOR PRESSURIZED H2 TANK



Schrader means pressure management for a large range of fluids such as air, air conditioning gas, fuels...Schrader has the abilities to design and manufacture several functionalities such charging ports, safety valves, pressure and flow regulators.

Pressure Thermal Relief Valve –protection in case of fire and over pressure.

To detect excessive temperature in a specific area Schrader has designed, based on a fuse tube which follows the cylinder areas to control potential over temperature. Then it's not anymore necessary to implement safety valves at each ends of the tanks.

The principle is as follows: the fuse tube is filled with a liquid under constant pressure. The liquid's pressure is created by a piston-spring system then this pressure is independent of the gas's pressure. And the advantage is that the fuse tube burns at the requested temperature. When the tube melts, the liquid is exhausted then the piston moves back. Consequently the gas sealing system is released.

www.schraderinternational.com

FRANCEOLE, EXCLUSIVE FRENCH COMPANY OF STEEL TOWERS FOR WIND GENERATORS



FRANCEOLE is mainly producing sections of towers, foundations pieces and «internals» in two facilities in Dijon and Le Creusot. FRANCEOLE offers today up to 600 segments equipped and finished per year to the «onshore» market. The Company also provides solutions for internal parts, platform design and production, foundation pieces, logistics solutions, services and repair works.

www.franceole.com

VALMÉTAL, CUSTOM-BUILT SPECIAL VEHICLES



Specialising in the transformation of metals by laser cutting and folding of long pieces, the company custom designs vacuuming and sweeping vehicles, and recently electric washers. Designer and assembler, Valmétal envisages several projects and partners for eco responsible vehicles. The sale of these first two electric washers to the city of Paris launches it into new markets and enables it to respond to more and more demands in terms of the environment, ecology and the cost of use.

www.valmetal.fr



RESEARCH AND INNOVATION, A PIONEERING SPIRIT

Scientific and innovative themes are at the interface of applicative and methodological approaches. They are supported by Hydrogen energy systems for co generation, coupling the renewable energy systems, the Hydrogen battery for transport and storage mobility and solid Hydrogen storage.

The development of stationary systems based on PEM electrolyzers for long term storage in the form of Hydrogen is included in the programme of scientific and technological developments, as the prognostic vision enables better regulation of a PAC system as regards its lifespan, a concept totally new in the world. The socio-economic dimension given to these projects is crucial, notably to better know and accept the use of Hydrogen as a combustible substance.

FCLAB-CNRS HAS JUST DOUBLED ITS CAPACITY FOR TESTS IN EXTREME CONDITIONS



With a 140 strong staff of researchers, teachers, engineers, doctorate students, administrative personnel, issuing from 5 laboratories³, the research federation (FR CNRS 3539) is the only one in Europe to combine research and engineering at a high level in public structure of such scope on this subject. The federation is supported by these institutions: FEMTO-ST ((Université de Franche-Comté / UTBM / ENSMM / CNRS), l'ICB (Université de Bourgogne / UTBM / CNRS), as well as, beyond regional borders, the laboratory AMPERE in Lyon (INSA, Centrale Lyon, Université de Lyon)

and two teams at l'IFSTTAR (Institut Français des Sciences et Technologies des Transports, de l'Aménagement et des Réseaux), the laboratories SATIE and LTE who have staff at Belfort, and of course the CNRS.

The combustible battery platform at UTBM is today one of the most important European public infrastructures intended for research, trials and industrial transition on the theme of combustible battery systems (900 m² geared up for trials of test powers in the region of 200 kW). The work that they have conducted has the purpose of positioning itself somewhat high in the TRL (Technology Readiness Level) scale, at least at the level of a functional representative prototype, and is thus very close to current industrial issues, the objective of course being to accelerate the industrial deployment of this technology.

It is therefore essential to be able to rapidly transfer the research work done notably by the research federation FCLAB installed mostly in the building. In this dynamic, several projects can be cited such as MobyPost currently in the industrial transfer phase and also the creation of the spin-off H2SYS, issuing from results of research conducted on the platform and currently accommodated in the latter.

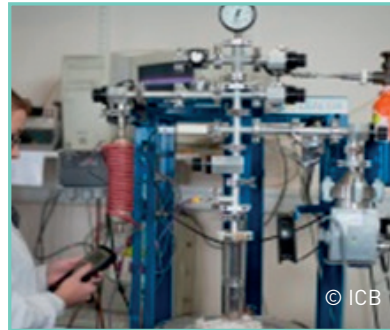
The ambition of this platform is to augment its industrial activity, notably by proposing new means of testing H₂ systems available to manufacturers, but also accompanying our partners in training their collaborators and licensing their products.

www.fclab.fr



Hydrogen Mobile Power Station © H2SYS

THE ICB LABORATORY

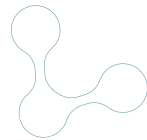


The **laboratoire Interdisciplinaire Carnot de Bourgogne** is a mixture of components associated with CNRS and attached to l'Université de Bourgogne and l'Université de Technologie de Belfort-Montbéliard. The research is structured along 6 lines:

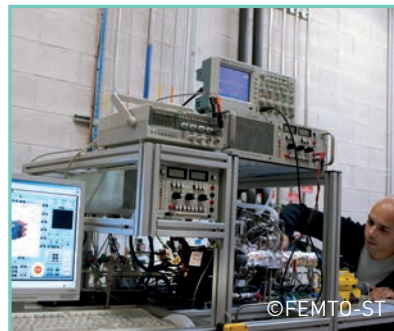
- Interactions & Quantum Tests
- Nano sciences
- Photonics
- Interfaces
- Metallurgic Procedures & Materials Durability (PMDM)
- Design, Optimisation & Modelling in Mechanics (COMM)

Research approaches: Interfaces, PMDM and COMM group 30 researchers who are developing work on combustible batteries SOFC and PCFC, high temperature electrolysis, PEMFC battery catalysers, hydrolysis, photolysis, hydrides, and hydrogen storage and purification. Research is based on the development of advanced materials, studying their durability, procedures and reactivity phenomena for solid/solid and solid/gas interfaces

icb.u-bourgogne.fr



FEMTO-ST



FEMTO-ST is a mixed entity associated with CNRS and attached to l'Université de Franche-Comté, l'École Nationale Supérieure de Mécanique et de Microtechniques and l'Université de Technologie de Belfort-Montbéliard.

Research is structured in 7 departments:

- Automation and micro-mechatronic systems
- Energy
- IT of complex systems
- Applied mechanics
- Micro, nano sciences and systems
- Optics
- Time-frequency

Activities linked to hydrogen energy are essentially developed in the Energy departments (hybrid systems, energy management, static converters, system optimisation, energy converters, health diagnostics, lifespan prognostics, fault tolerance tests, integration in transport and stationary applications), AS2M lifespan prognostics, link with maintenance), applied mechanics and MN2S (solid hydrogen storage).

www.femto-st.fr





RESEARCH AND INNOVATION, A PIONEERING SPIRIT

1 COMPETITIVENESS CENTRE & 1 CLUSTER

In figures:

375 adherents
163 projects financed with 563 M€

1,000 companies, 160,000 linked jobs
to the Centre's themes.

www.vehiculedufutur.com

Pôle Véhicule du Futur

The Pôle Véhicule du Futur cluster brings together industrial actors, academics and training in the domain of vehicles and transport of the future; Hydrogen is included in this strategy. The Centre has as its mission to improve companies' competitiveness: innovation, performance and growth.

In the region, it pilots the industrial strategy on Hydrogen and accompanies the companies in this emerging domain.

At the national level, the Centre participates in the consortium "Mobilité Hydrogène France", a French initiative in the continuity of

"H2 Mobility" studies in Germany and the UK. It is a member of AFHYPAC. The Centre has received the "gold label", a European label which rewards excellence of clusters.

In figures :

80 members of which 60 companies
1,000 staff

www.windforfuture.com

WindForFuture

The objective of the cluster is to create synergies between companies in the domain of wind power in Bourgogne-Franche-Comté. By its actions, W4F favours the development of collaborative businesses and projects in France and abroad as well as referring member companies to large orderers. It participates to value professions and know-how,

innovation, personnel training needs. The cluster is interested in Hydrogen as a storage method for wind energy. Partner of the project Éolebus at Auxerre (89).



TRAINING TO IMAGINE AND DESIGN THE ENERGY SYSTEMS OF TOMORROW

The territory offers a broad and varied range of qualifying training, targeted, organised according to precisely identified needs. The training is thought through and implemented, not only in its contents, but also in its rhythms, to adapt permanently to scientific and technological developments: Training diplomas short or long, by primary, continuing training or apprenticeships.

AN ENGINEERING MASTERS COURSE (CMI) UNIQUE IN FRANCE

The Hydrogen Energy and Energy Efficiency CMI offered by the University of Franche-Comté educates engineers over 5 years in techniques of the production of clean energies, with a particular ability in the domain of Hydrogen technology.

UNIVERSITY OF FRANCHE-COMTÉ BESANÇON

- Has a teaching platform around Hydrogen Energy.
- **20,292 students**
- Science masters for engineers:
 - Thermal and energy engineering
 - Electrical engineering
 - Hydrogen Energy CMI and energy efficiency
- Professional science degree for engineers/
 - Electrical and energy engineer
 - Energy and climate engineering, speciality Renewable energies
 - Speciality maintenance and energy
- DUT:
 - Electrical engineering
 - Civil engineering
 - Thermal energy

UNIVERSITY OF BOURGOGNE DIJON

- **29,390 Students**
- Masters in sciences:
 - Testing & Durability of Matériels
 - Chemical Testing & Analyses
 - Physics Laser et materials
 - Physics Laser et materials
- DUT:
 - Mechanical and production theory engineering
 - Civil engineering
 - Physics Measures
 - Sciences and materials engineering



www.ubfc.fr

UNIVERSITY ENGINEERING SCHOOLS



© UTBM

UT BELFORT-MONTBÉLIARD

- **2,800 students**
- The Energy department
- 4 domains:
 - Energy production
 - Networks, conversion and storage
 - Transports and systems in-vehicle systems
 - High energy efficient buildings
- 2 teaching platforms:
 - Electromagnetic accounting
 - Terrestrial energy and transport
- 1 engineering training electrical engineering by apprenticeship
- 1 masters in electrical engineering

www.utbm.fr



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ENSMM BESANÇON

National centre for education of engineers in the domains of systems engineering and mechanical micro systems and mechatronics.

- 900 students
- Educating engineers in 3 years
- 9 options in 3rd year, of which:
 - Energy and Transport
 - Innovation engineering
 - 1 masters in Industrial and Innovation Engineering
- 6,618 graduated engineers working
- 4 research departments

www.ens2m.fr



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ESIREM DIJON

L'École Supérieure d'Ingénieurs en Matériaux offers 2 specialisations:

- Materials - Sustainable Development
- IT- Electronics

With 9 month internships in companies, 3 month internships abroad and a network of more than 200 companies, the education favours rapid and multi-sector professional insertion: energy, metallurgy, transport, IT, R&D, telecommunications.

The research:

- 28 teacher/researchers
- 5 laboratories included in the school,
- Research Masters
- 8 patents applied for

esirem.u-bourgogne.fr



© ISAT

ISAT NEVERS

L'Institut Supérieur de l'Automobile et des Transports has educated for more than 25 years engineers at the international level for the whole automobile and transport domain: innovation and R &D, design, industrialisation and production, use of vehicles/engines...

- 670 students
- 2 authorised engineering courses under student and apprentice statutes
- 2 research masters

ISAT demands on the research laboratory DRIVE, Research Department in Engineering of Vehicles for the Environment.

www.isat.fr

“

WE HAVE IN BOURGOGNE-FRANCHE-COMTÉ ALL THE CONSTITUENT ELEMENTS OF A CLUSTER, WHICH HAS ENABLED US TO BEGIN DEVELOPING EXPERIMENTS, EXPERIMENTS WHICH LEAD TO INDUSTRIALISATION TO RESPOND TO THE NEEDS THAT ALL OF OUR SOCIETIES ARE CONFRONTED WITH.

”

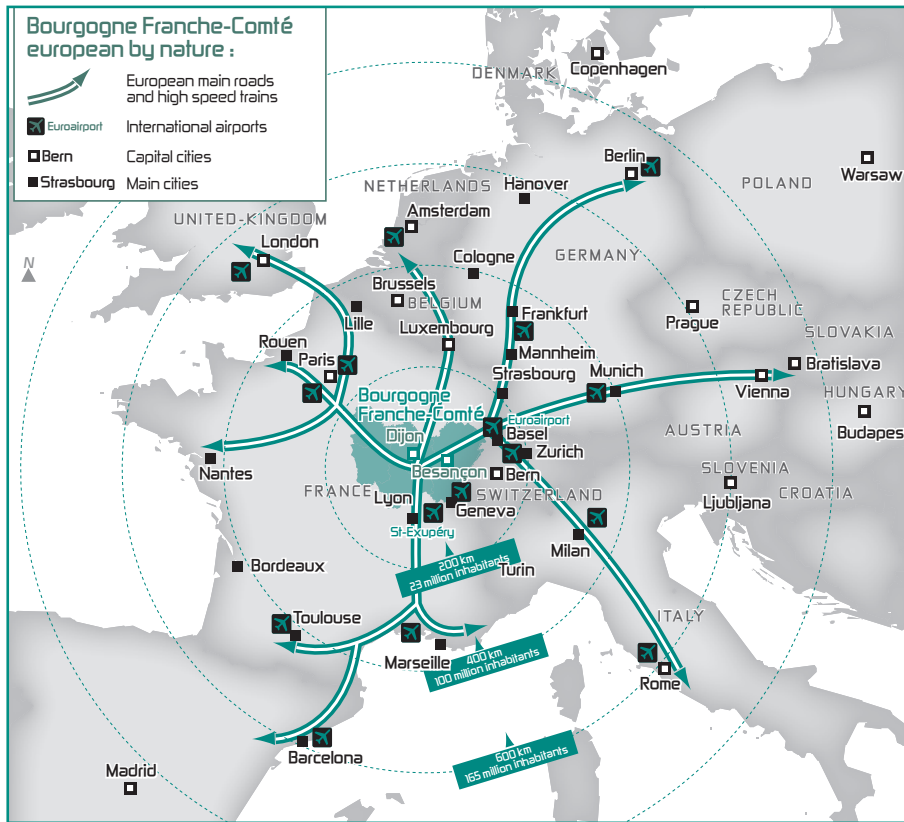
Denis SOMMER,
Regional Advisor delegated «new growth»

A FAVOURABLE ENVIRONMENT...

BOURGOGNE-FRANCHE-COMTÉ, AT THE HEART OF EUROPEAN MARKETS

The size of the market is one of the pillars of France's competitiveness: a national market of more than 67 million inhabitants, opening access onto the European market (742 million inhabitants). Demographic growth in France is one of the most dynamic in Europe. Mainland France may have 74 million inhabitants in 2050 of whom 32.9% more than 60 years¹.

Bourgogne-Franche-Comté has 2.8 million inhabitants. Its geographical position puts it at the heart of a market of more than 227 million Europeans in a radius of 800 kms of whom 45 million are less than 4 hours from Dijon by road.



A LOCATION NATURALLY STRATEGIC

One of the attributes of France is that it is a global and connected economy. With nearly 5,853 km of coastline and more than 890 km of borders touching 6 countries and 2 principalities, France is an entry gate into Europe.

Because of its geographical position, crossroads North-South and East-West, Bourgogne-Franche-Comté can benefit from a strategic location at the heart of Europe.

EFFICIENT INFRASTRUCTURES

France is endowed with efficient infrastructures which enable it to be classed in the 4th rank for its railway network, 6th for its road network, and 8th for the totality of its infrastructures, out of 130 countries, according to the 2016 report on competitiveness by the world economic Forum.



- 4 national airports
- 1 regional airport Dole-Jura
- 35 aerodromes
- 1h00 London**
- 2h00 Nice, Toulouse, Barcelona, Madrid, Brussels, Berlin, Lisbon**



- 2,181 km of classic lines
- 442 km of VFT
- 14 VFT stations
- 1h40 Paris, Lyon, Strasbourg, Fribourg**
- 3h00 Lille**
- 4h00 Marseille**



- 9 motorways
- 902 km of motorways
- 775 km of national roads
- 1h00 Airport Bâle-Mulhouse**
- 2h00 Paris Roissy-CDG**
- 2h10 Lyon Saint-Exupéry**
- 2h30 Genève-Cointrin**



- 1,612 km of river routes
- 27 marinas
- From North Sea to the Mediterranean Sea
- From The Rhine to the Rhône



- 230 km of border with Switzerland

EXPERT GUIDING

The Bourgogne-Franche-Comté region has fixed as an objective to Remain at the cutting edge of research and deployments related to Hydrogen energy. Industry, authorities, research organisations work in a coordinated manner to foster the emergence in Bourgogne-Franche-Comté a domain ready for massive use of Hydrogen.

STRUCTURING IN ACTIONS

Under the auspices of the region and the Pôle Véhicule de Futur cluster, various work groups contribute in a structured way to the production not only the prospective vision but also short term action plans.

This thematic dossier was executed by l'Agence Régionale de Développement de Franche-Comté, in the context of its mission to promote the economy. This action is financed by the Conseil régional de Bourgogne-Franche-Comté



SOURCES

1. Hydrogen Council
2. Figures issued by the base ACOSS on 31st December 2015 / Business France
3. Developed space: covering urbanised and industrial zones and commercial zones, transport networks, mines, quarries, tips and building sites, also urban green spaces, fitted with sporting and leisure equipment (INSEE)
4. L'Institut FEMTO-ST (25) associated with l'UFC, at CNRS, at l'ENSMM and l'UTBM, LTE (69) and SATIE (78) laboratories of l'IFSTTAR, the laboratory AMPERE associated with l'Ecole Centrale de Lyon, at l'INSA of Lyon and l'Université de Lyon 1

CRÉDITS PHOTOS

ARD Franche-Comté, Augé Microtechnics Group, Belfort, Conseil régional, Décolletage de la Garenne, Denis Maraux, Fédération FCLAB, Gaussin Manugistique, General Electric, Groupe La Poste, H2SYS, ISAT, MAHYTEC, MobilhyTest, MobyPost, Plastigray, R Bourgeois, Université Technologique de Belfort-Montbéliard, Université de Franche-Comté – DR.

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L'**ARDIE** (Agence Régionale de Développement de l'Innovation et de l'Économie) and l'**ARD** (Agence Régionale de Développement) Franche-Comté have as their mission **the development of the economy and attractiveness of the territories of Bourgogne-Franche-Comté.**

- Favour the establishment of new economic activities,
- Take over from the Conseil régional in order to stimulate the regional ecosystem by means of economic development and innovation,
- Contribute to the development of structured and emerging sectors and enhance their value,
- Ensure an economic territorial engineering service,
- Promote the attractiveness of Bourgogne-Franche-Comté,
- Ensure service in proximity to companies and territories,
- Participate in the development of companies concerned.

Overall, they offer service extending to investors, project leaders, entrepreneurs and territories. These actions in the Schéma Régional de Développement Économique, d'Innovation et d'internationalisation (SRDEII), a real economic strategy which fixes the challenges and major objectives necessary for the reinforcement of regional competitiveness.

Our two agencies are supported by a network of actors who place initiative, innovation, sustainable development and an international perspective at the heart of a dynamic which participates in job development.

In the context of the fusion of the French regions, the two agencies are in the process of structuring their activities in order to form a single Agency.



ARDIE - Maison Régionale de l'Innovation
64 A, rue Sully - CS 77124 - F-21071 Dijon cedex / France
Tél. +33 (0)3 80 40 33 88
www.ardie.fr



Agence Régionale de Développement de Franche-Comté
3, rue Victor Sellier - F-25000 Besançon / France
Tél. +33 (0)3 81 81 82 83
www.ardfc.org

