

ANNUAL REPORT 2022 - 2023

Cerema's scientific excellence for the benefit of the French economy
and its adaptation to the effects of climate change



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Clim'adapt,
member of the
Carnot network

Editorials

"As a local elected official, I appreciate the value of Cerema's contribution to our sometimes complex ecological transition and sustainable development projects.

Once again this year, our partners in the socio-economic sphere were able to draw on Cerema's cutting-edge expertise, the reliability of its innovative solutions, and the quality of the guides and methods distributed by its publishing house."



Marie-Claude Jarrot

Chairperson of the Board of Directors of Cerema

"2022-2023 proved to be pivotal in Cerema's development.

Against a backdrop of accelerating climate change, our teams were up and running alongside businesses, local authorities and the French government.

We developed and provided tools and methods to support local and regional authorities: energy efficiency in school buildings with the Cube.S programme, low-carbon mobility, urban restoration, improved water management, natural risk prevention and dealing with the receding coastline.

The passing of France's 3DS law (to decentralise, deconcentrate and differentiate local action) marked a major

turning point in the life of Cerema by changing its status and allowing local authorities to come on board. We now seek to build on this momentum, which makes us the first national institution shared by the State and local authorities to provide access to high-level research and expertise throughout France.

Accordingly, we are pursuing these new partnership relations with our member local authorities and the actions undertaken in the scope of major undertakings such as Destination France for sustainable tourism, the National Bridges Programme, our European and international activities, as well as research and innovation with numerous partner companies as part of our Institut Carnot Clim'adapt and CeremaLab."



Pascal Berteaud

Director General of Cerema

“As underscored by the French High Council for the Climate (Haut conseil pour le climat) in its latest report, 2022 was a particularly hot and dry year in France, with serious impacts on people, economic activities, infrastructures and ecosystems. This exceptional year, in which the difference in temperature compared with the average [1900-1930] came close to +3°C, is set to become the norm by 2050-2060, for a global warming level of +2°C.

On the basis of the public policies currently being implemented around the world, an average temperature increase of around 4°C is projected for mainland France by the end of the 21st century, added to which are the effects of natural variability.

This scenario confirms the urgent need to anticipate and act through policies and work focused on adapting our country to the effects of climate change. These actions need to be based on science, drawing on a wide range of economic sectors and disciplines to build a holistic vision of the problem.

By providing experts with further insight, Cerema’s six complementary fields of activity and twelve research teams ensure that the institution is able to identify all causes and effects and, in so doing, reduce the risk of maladaptation.

The hierarchy of issues involved in adapting to the effects of climate change faced by socio-economic players varies by region. Fortunately, thanks to the geographic mesh of its regional sites, Cerema can help companies and local authorities implement their transitions in a way that anticipates and accommodates this local dimension.

Being able to work with these two types of players (and occasionally acting as their interface) is a strength for Cerema, as their respective problems go hand in hand. The lifeblood of local authorities is economic activity, which is itself essentially driven by businesses.

The climate challenge, reinforced by the legitimate quest for greater national sovereignty in certain sectors deemed strategic, gives rise to new issues that naturally lead to partnership research actions, which lie at the heart of the Carnot system.

The 2022-2023 period was marked by a number of events and developments that have had a structuring effect on the development of Institut Carnot Clim’adapt, and which you will discover below.

Looking ahead, 2024 is set to be a busy year with, in particular, the call for proposals for the renewal of the Carnot labeling.”



Thierry Braine-Bonnaire
Director of Institut Carnot Clim’adapt

Cerema's Institut Carnot Clim'adapt

Institut Carnot Clim'adapt operates under the supervision of Cerema, a public institution overseen by the French Ministry for ecological transition and territorial cohesion. With 26 sites and 2,500 employees, and present throughout mainland France and the French overseas departments and territories, it is the first institution to be managed jointly by the State and local authorities.



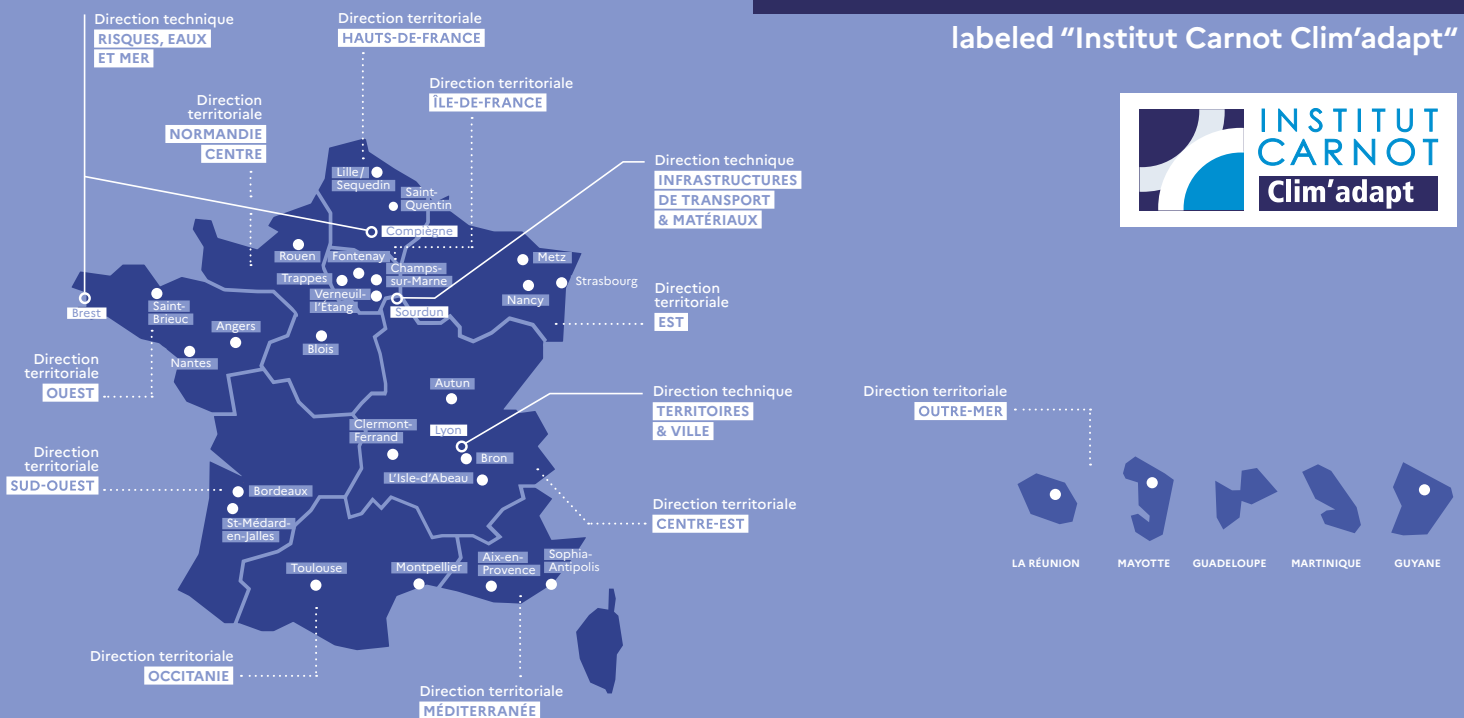
Drawing on more than 50 years of history and expertise in land-use planning, **Cerema works alongside the State, local authorities and businesses** to help them rise to the challenges of the ecological transition.

Cerema is now **France's public expert in adapting to climate change**. Every day, it develops scientific knowledge and helps to deploy technical solutions to make people's lives safer and better. As guarantor of the public interest, it gathers knowledge and know-how for the benefit of public and private players so that they can solve complex problems.

With its considerable potential for innovation and research, embodied notably by Institut Carnot Clim'adapt, Cerema is active in six fields of activity: Regional expertise and engineering, Building, Mobility, Transport infrastructure, Environment and risk, Sea and coast.

MAP OF CEREMA SITES

labeled "Institut Carnot Clim'adapt"



Cerema
in figures

2,500
employees

26
sites in mainland and
overseas France

€359m
annual budget

To find out more: [Cerema 2022 Annual Report](#)

Through its service offering, Cerema can support its public and private partners in their transitions more efficiently in the field. **The institution is now positioned in six main areas of expertise, where the underlying objective is to help territories adapt to climate change.**

Regional expertise and engineering to support land-use planning transition strategies

- Regional strategy and development
- Knowledge and mobilisation of land
- Adaptation to climate change



Building to control the impact of buildings on the climate and improve their quality of use

- Real estate heritage management
- Environmental and energy performance
- Comfort and ventilation of buildings
- Geo- and bio-sourced materials
- Construction economics and legal frameworks
- Digital building
- Universal accessibility in buildings



Mobility to promote sustainable and safe mobility

- Public spaces and urban roads
- Recognising, modelling and assessing mobility
- Mobility policies and services
- Intelligent transportation systems, traffic and regulation
- Road and travel safety



Transport infrastructure to secure and sustain transport infrastructures, notably in the face of climate change

- Transport infrastructure asset managements
- Transport infrastructure techniques, methods and monitoring
- Asset management for engineering structures
- Engineering structure techniques, methods and monitoring
- French national emergency bridge centre - CNPS



Environment and risk to control natural risks and their impact on the environment, the climate and the consumption of resources used in land development and transport projects

- Renewable energy sources
- Biodiversity and planning
- Water and the management of aquatic environments
- Construction and civil engineering circular economy
- Natural risks
- Reducing pollution and planning



Sea and coast to ensure the safety and sustainable development of marine and river activities by controlling their impacts on the environment, and adapting maritime and coastal areas to the changing climate

- Sea and coastal management
- Security and maritime and river traffic
- Ports and inland waterways



Cerema highlights 2022-2023

Central to Cerema's new status: the vote on the 3DS law

Published in the Official Journal of 17 June 2022, the decree that implements clause 159 of France's 3DS law of 21 February 2022 marked an important step in the development of Cerema, which is now the first public institution to be managed jointly by the State and local authorities. Relating to differentiation, decentralisation and deconcentration, and covering various measures for applying local public action, this law makes it easier to access Cerema's expertise via a simple agreement, without having to proceed via a call for tenders.



Cerema the solution provider at the COP 27

At the United Nations Climate Change conference in Sharm el-Sheikh, Egypt, on 6-18 November 2022, Cerema presented its concrete solutions for reducing greenhouse gas emissions and readying coastal and urban areas for climate change:

- the RE-MED trans-Mediterranean project, which aims to recycle demolition waste for road construction and maintenance;
- coastal management work to promote a more resilient blue economy;
- work carried out with the French Partnership for Cities and Territories for the development of a desirable and inclusive city by 2050.

Creation of Cerema's Overseas Territories regional division

As of 1 January 2023, Cerema's Overseas Territories delegation became a fully-fledged regional division ("*direction territoriale*"). Located in Mayotte, La Réunion and French Guiana, this division consolidates the Group's presence in French overseas territories and its commitment to supporting these regions in their transition. It is now the gateway to all Cerema's expertise in France's overseas territories.



JUNE 2022

NOVEMBER 2022

JANUARY 2023

Expert research for the benefit of regions

Cerema, a recognised research player in France

In the summer of 2021, the publication of the decree establishing the list of public institutions whose statues provide for a research mission formally marked **Cerema's recognition as an organisation with research missions**. This new step confirms the scientific strategy endorsed by the strategic project, along with its objectives and performance contract, also adopted in 2021.

And so, for the first time Cerema will be assessed by the High Council for the assessment of research and higher education (*Haut Conseil de l'évaluation de la recherche et de l'enseignement supérieur* - Hcéres). This will take place in 2024-2025 along with the assessment of the objectives and performance contract, currently being drawn up.

Scientific teams integrated in higher education

In 2022, the effort to structure the research teams, initiated since the creation of Cerema in 2014, was actively pursued in each of the major fields in which the institution is scientifically involved

The creation of joint research units (*Unités Mixtes de Recherche - UMR*) was consolidated in 2022-2023 with three objectives:

- fully incorporating the teams into the French higher education and research system (the teams integrated in joint research units will themselves be assessed by Hcéres);
- improving the framework for hosting doctoral paths to make it even more attractive;
- allowing Cerema to ensure the scientific supervision of these joint research units.

In this respect, two new joint research units saw the light of day on 1 January 2022:

- the Mobility, Planning, Transport, Risks and Society (*Mobilités, Aménagement, Transports, Risques et Société - MATRIS*) unit, co-supervised with CY Cergy Paris University;
- the Materials for Sustainable Construction (*Matériaux pour une Construction Durable - MCD*) unit, co-supervised with Gustave Eiffel University.

DISCOVER
all our
research groups



An active doctoral programme

In 2022, 14 theses were defended and 26 directed or co-directed by at least one Cerema researcher, in collaboration with an academic team. In all, Cerema accommodates 57 doctoral programmes within its teams.



DID YOU KNOW?

How can we prepare for the future in terms of maintaining infrastructure and engineering structures? This is the subject of the **thesis by Diego Navarro, funded by Institut Carnot Clim'adapt** as part of the [ROAD-AI challenge](#) with Inria.



2022-2023 Research highlights

Lighting and Illumination: creation of a new research team

Located in Cerema's branch in Angers, France, the new Lighting and Illumination (*Éclairage et Lumière* - EL) research team spent the first half of 2022 actively charting the way forward. Cerema's management committee approved the creation of this team in the autumn of 2022.

The EL team is focused on characterising the perceptual conditions of those who use roads and public spaces in order to improve the quality of service of urban developments and infrastructure. This serves not only to meet the visual expectations of people on the move, but also to limit the impact of anthropogenic needs faced with the challenges of the ecological transition. The team's research focuses specifically on the fields of street lighting and visibility.

The Alfred Monnier 2023 prize awarded to Cerema researcher Valérie Muzet

On 6 June 2023 in Paris, the French Lighting Association (*Association Française de l'Éclairage* - AFE) awarded the 2023 Alfred Monnier prize to Valérie Muzet, a researcher in Cerema's ENDSUM research team. This prestigious award acknowledges all the work carried out in favour of lighting by this expert in the photometry of road surfaces (coverings and markings) over the last twenty years.



SEE
the portrait of Valérie Muzet
and that of other Cerema researchers

Meeting of the building air permeability community in Bron

On 21 June 2023, the Perméa community met to take stock of the major advances made in the airtightness of buildings. Organised by Cerema's Efficient Buildings within their Environment (*Bâtiments Performants dans leur Environnement* - BPE) research team, the meeting was a chance for players in the field to get together for the first time in four years, and to exchange views with researchers from the University of Nottingham, who had come to present the regulatory context in force in the United Kingdom.



* in 2022



103
rank-A
publications*

129
communications
during conferences*



57
theses in
progress

14
theses
defended*



Institut Carnot Clim'adapt in 2022-2023

Institut Carnot Clim'adapt: offer and missions

Cerema benefits from the "Institut Carnot" labeling for its Clim'adapt project, a veritable bridge between public research and the socio-economic world. **This is the first time that the Institut Carnot labeling has been awarded to a project focused on climate change.**

Institut Carnot Clim'adapt helps businesses and regional authorities to address the climate challenge and implement their transition towards a low-resource, low-carbon economy that respects the environment.

Through bilateral contract research services, Cerema provides these economic stakeholders with the scientific excellence of its researchers and experts, in the institution's six fields of activity:

Regional expertise & engineering



Building



Mobility



Transport infrastructure



Environment & risk



Sea & coast



These multidisciplinary, complementary areas of expertise enable Clim'adapt to develop solutions for adapting to climate change by incorporating the topic's systemic aspect and, accordingly, the resulting effects.

Today, Institut Carnot Clim'adapt plays a **key role as the interface between businesses and regional authorities** for the scientific and technical issues relating to economic development and land-use planning.

This represents a real opportunity to **deploy and test innovative solutions.**

In this context, **Clim'adapt has a threefold mission:**

- **transfer Cerema's R&D to businesses** in order to support them with their ecological transition and their adaptation to climate change;
- **help businesses to overcome technological obstacles** so that they can develop innovative and suitable solutions, characterise them in controlled conditions and try them out in the field (via collaborative research projects, joint laboratories, industrial chairs, etc.);
- **support local authorities** to identify and implement solutions that match their needs **via partnership research.**

Clim'adapt provides **solutions at the cutting edge of R&D** on its various research topics, compatible with – and forerunners of – the **necessary mitigation and adaptation of regions to climate change.**





ECONOMIC SECTORS AND AREAS OF ACTION

Energy transition and climate change



Sustainable buildings

Towns and urban strategies

Regional development and cohesion

Infrastructure design management



Mobility and transport

Circular economy

Management of natural resources



Respect for the environment

Prevention of natural risks

Well-being and pollution mitigation

With its **strong regional roots**, Institut Carnot operates in close proximity to its customers and their needs. It provides them with Cerema's R&D results, skills and resources in the fields of observation, instrumentation, measurement, analysis and modelling to understand and anticipate how their products or services work and assess their impact.

Clim'adapt also provides its partners with its **Prototypes and Digital Projects Department (DPPN)**, and its **Experimentation and Research Centre (CER)**. These enable key stages of technological development to be reached at scale 1 in the fields of instrumentation, sensors, navigation aids, surveying equipment, etc.

DID YOU KNOW?

Institut Carnot Clim'adapt develops partnership research, i.e. research work carried out by public laboratories in partnership with socio-economic players, companies of all sizes, and local authorities, in response to their needs.

"Cerema is fully committed to adapting to climate change in its six fields of activity. With its numerous research and expertise projects, it has held the Carnot Clim'adapt Institute labeling for several years now. Its twelve joint research teams, its experts familiar with the research and experimentation activities of companies, and tools such as CeremaLab (a system for accelerating innovative projects by SMEs and start-ups) are all assets for developing its partnership research."



Ariane Angelier

Director of Cerema's Research, Innovation and International activity since 1 July 2022

Key figures

In 2022, the combined revenues from Cerema's Carnot activity amounted to **€5.4m***.

Partnership research covers a broad range of customers, fields of activity and geographical sectors, as illustrated by the graphs below. In addition, France's diverse regional territory offers a particularly rich field for experimentation.

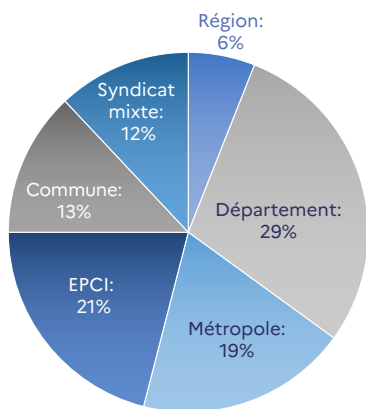
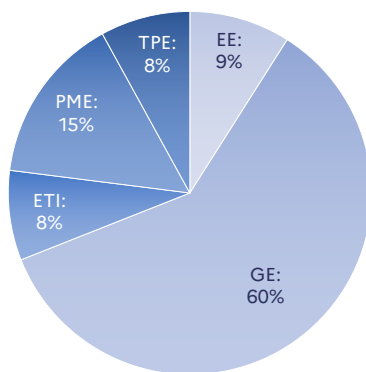
**Figure eligible for Carnot submitted to the French National Research Agency (ANR) for 2022 revenues.*

Breakdown of contracts

BY TYPE OF COMPANY

Cerema supports all types of businesses, in particular large groups, in their search for solutions to adapt to climate change: 10% of the overall revenue generated with businesses comes from partnership research.

EE (OC):	Overseas companies	9%
GE (EG):	Large companies	60%
ETI (MSC):	Mid-sized companies	8%
PME (SME):	Small and medium-sized enterprises	15%
TPE (VSE):	Very small enterprises	8%



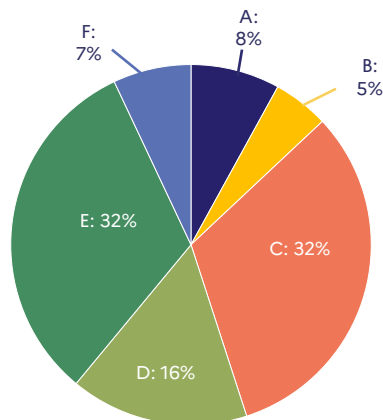
BY TYPE OF LOCAL AUTHORITY

Cerema works with decision-makers at local and regional levels to develop new strategies for adapting to climate change.

Région	6%
Département	29%
Métropole	19%
EPCI (public inter-municipal cooperation establishment)	21%
Commune (municipality)	13%
Syndicat mixte (joint association)	12%

BY CEREMA FIELD OF ACTIVITY

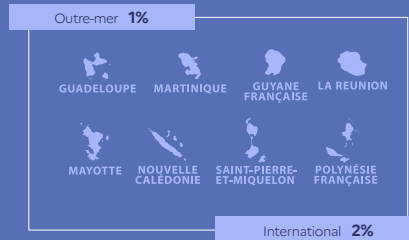
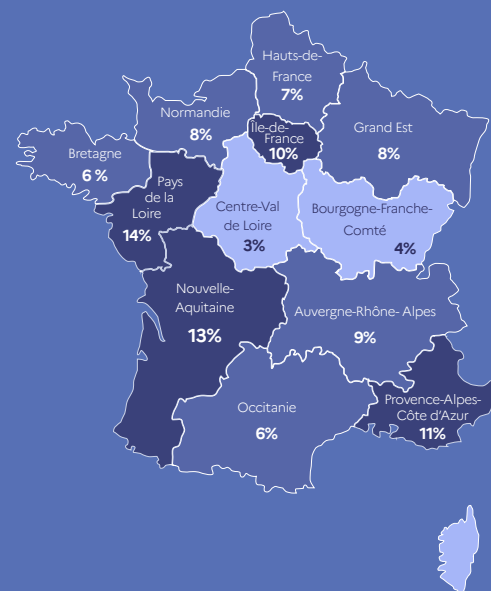
The fields of activity most frequently represented cover a wide range of issues, such as preservation of ecological continuity, development of innovative materials, new types of signage, autonomous vehicles, research into innovative methods for inspecting engineering structures, etc.



Field A:	Regional expertise and engineering	8%
Field B:	Building	5%
Field C:	Mobility	32%
Field D:	Transport infrastructure	16%
Field E:	Environment and risk	32%
Field F:	Sea and coast	7%

Contribution of French regions to revenue

- Less than 5%
- Between 5 and 10%
- More than 10%

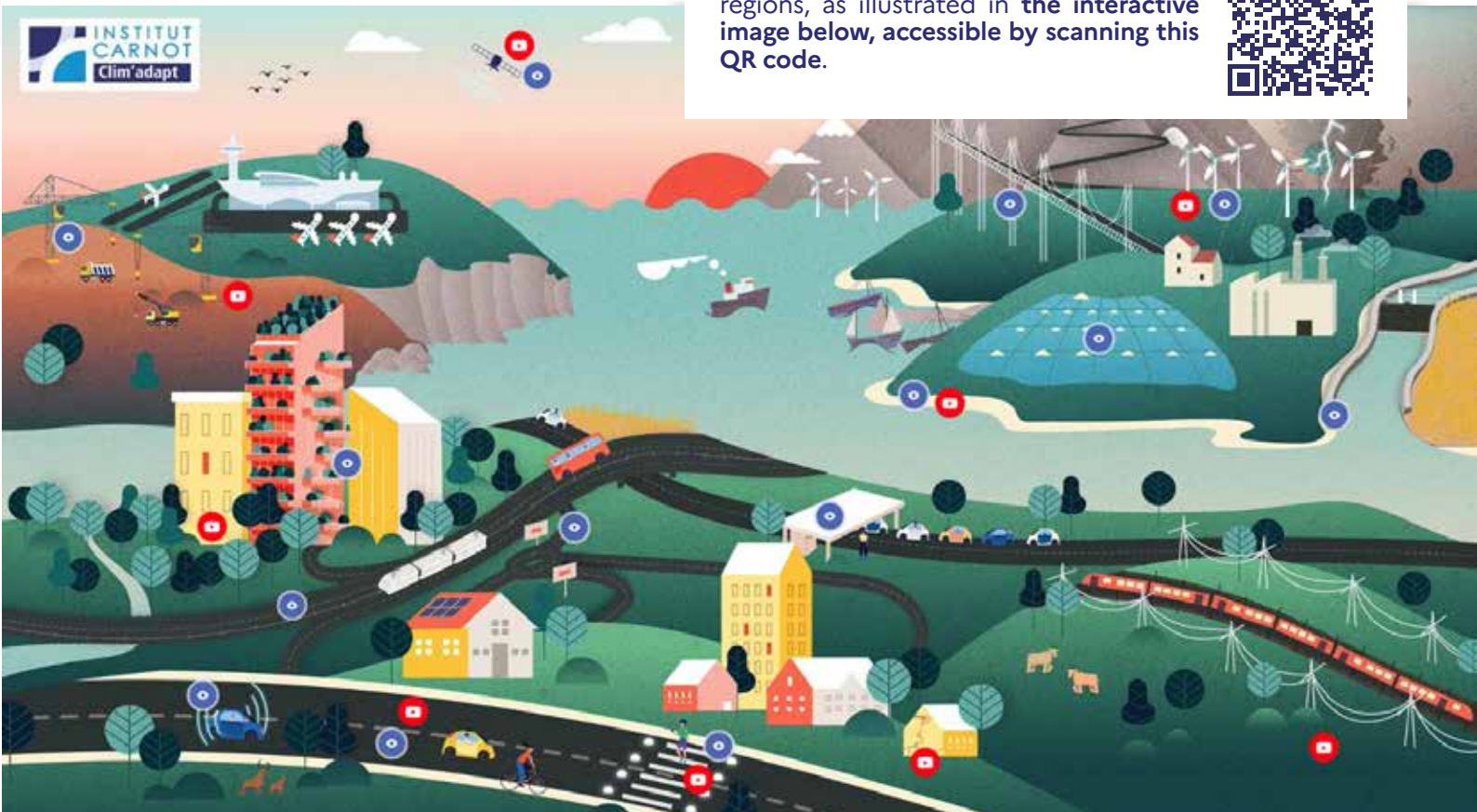



A very extensive regional coverage for partnership research that meets local specificities and issues, while ensuring that the results of this research can be effectively reproduced.


Focus on several Carnot contracts

In recent years, and in particular over the 2022-2023 period, Cerema, holder of the Institut Carnot Clim'adapt labeling, has entered into numerous contracts with companies and local authorities.

These projects concern very many regions, as illustrated in the interactive image below, accessible by scanning this QR code.



 By clicking on the blue circles, you can see all our **"successful partnership stories"**, positioned in the landscape according to their corresponding topic.

 By clicking on the red circles, you can access **videos** (also available on the **"Cerema research" YouTube playlist**) that shine a light on some of our collaborations.

The proportion of partnership research contracts aimed at meeting the climate challenge – in terms of mitigation and adaptation – is growing every year. Between 2017 and 2022, it jumped from 27% to 46% (in terms of value).

Examples of themes covered by Carnot contracts that tie in with adapting to climate change:

- Analyses of all kinds of vulnerability
- Monitoring and management of coastlines
- Impact of global warming on the mechanical operation of structures
- Risks analysis by automatic measurement processing (AI)
- Decision support for regional development
- Satellite observation and analysis of territorial resilience
- Indoor air quality and summer comfort during heatwaves
- Local cooling and the fight against urban heat islands
- Management of ports and waterways
- Management of water, including urban rainwater



DID YOU KNOW?

Cerema works alongside innovative start-ups and SMEs via its CeremaLab support facility, which actively pursues Clim'adapt's objective of stepping up interactions for bilateral partnership research with small businesses (see p. 19).



Key events 2022-2023

In 2022-2023, Institut Carnot Clim'adapt presented Cerema's offer at a number of events. **The Clim'adapt team also organised and attended various events in the presence of Cerema's researchers and experts,** as illustrated by the frieze below:



5 July 2022

CAP'CARNOT

2022

SEPT.

OCT.

NOV.

12-13 October 2022

**LES RENDEZ-VOUS
CARNOT**

(see double page overleaf)

27 September 2022

**ECOTECH MEETING
ON RAINWATER
MANAGEMENT
IN URBAN AND
INDUSTRIAL
ENVIRONNEMENTS**

(see double page overleaf)

25 October 2022

**Internal webinar
"Developing partnership
research with businesses"**

1 September 2022

**Launch of the call for scientific
resourcing projects** by Institut
Carnot Clim'adapt (FY 2023)

14 September 2022

**Cerema Normandie-Centre
regional office, Le Grand-Quevilly**

**Workshop on the development
of partnership research**

in the presence of researchers,
business managers and two
representatives of the Association
of Carnot institutes (AiCarnot):
Jean-Denis Muller, Director
General, and Pierre Gohar,
Director of Industrial Relations

23 September 2022

**Cerema and Institut
Carnot Clim'adapt
featured on TF1's TV
news programme** in the
scope of a report on the
shrinkage-swelling of clay
soils



20-21 September 2022

INNOPOLIS EXPO PARIS



15 September 2022

Thierry Braine-Bonnaire, Director of Institut Carnot
Clim'adapt, guest on the **Batiradio podcast Portraits
of committed players - Pioneers of the sustainable city**





22-24 November 2022

Paris
EXHIBITION FOR MAYORS
AND LOCAL AUTHORITIES

8 June 2023

Paris
NATIONAL MEETING OF
INNOVATION DIRECTORS



22-23 June 2023

Carnac
CARNOT SEMINAR

7 June 2023

Paris
Meeting of business managers
Carnot, with several participants of
Carnot Clim'adapt

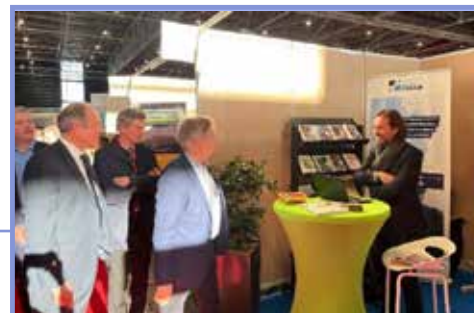
JUNE

29 November 2022

Paris
CLIM'ADAPT STRATEGIC
DIRECTION COMMITTEE
(SDC) MEETING

6 April 2023

Paris
NATIONAL
ECO-BUSINESS FORUM



4-5 April 2023

Metz
URBEST TRADE SHOW

APR.

DEC.

8 December 2022

STRATEGIC SEMINAR
FOR CARNOT DIRECTORS

FEB.



6 February 2023

Bron
Visit to Cerema by Jean-Michel Le Roux, head of the
Carnot institutes programme for the French National
Research Agency (ANR)

2023

Resounding success of the ECOTECH MEETING

on rainwater management in urban and industrial environments

On 27 September 2022 in Paris, Carnot Clim'adapt and Carnot Eau & Environnement co-organised – with PEXE, France Water Team, Bpifrance, OFB, the water agencies, ADOPTA and Suez – the first Ecotech Meeting dedicated to rainwater management in urban and industrial environments. The aim of the event was to showcase innovations from laboratories, start-ups and SMEs intended for key accounts and local authorities looking for sustainable rainwater management solutions, and to facilitate networking to speed up this transition.

More than 200 participants attended, 80% of whom in person, and almost 180 B2B meetings were held. The diversity of the sectors present illustrates the growing awareness of these issues among economic players, with representatives from ports, airports, the world of sport, chemicals, aviation, construction, events, retail, logistics, real estate, energy, water, biodiversity, local authorities, finance and the French State.

Three sequences were covered during the day:

- Integrated rainwater management;
- Networks, collection and storage;
- Sustainable solutions for treating and reusing rainwater.

Several Cerema researchers and experts took part in the plenary session: Thierry Braine-Bonnaire, Director of Institut Carnot Clim'adapt; Christine Féray, Head of the "Water and management of aquatic environments" activity; Philippe Branchu, researcher and member of the TEAM research team; Marie Ballère, Head of satellite observation studies at the Occitanie regional division; Emmanuel Berthier, research engineer in urban hydrology (TEAM); David Ramier, research engineer in urban hydrology (TEAM); and Ivana Durickovic, Innovation Manager (TEAM).

A number of concrete, accomplished solutions were presented to participants, including adaptation to climate change, reversal of soil sealing, ecological engineering, decentralised water management, integrated rainwater management, risk management, heat islands, micropollutants, micro and macro waste, digital tools, sensors and decision-making and support tools, urban pollution, reuse of water for spaces, and nature-based solutions.



“With our friends from Carnot Eau & Environnement, and several other partners, we organised an Ecotech day devoted to the management of rainwater in cities. This is something that we are constantly reminded of, often with dramatic consequences, in the national, European and global news.

For centuries, towns sought to separate and protect people from the natural environment, including water, often perceived as a threat. Today, climate change, loss of biodiversity, increasingly frequent and severe extreme events, and the demands of a largely urbanised society for greater proximity with nature are completely reshuffling the cards.

All of these issues were covered by the presentations and discussions on 27 September 2022.”

Thierry Braine-Bonnaire
Director of Institut Carnot Clim'adapt

Gestion des eaux pluviales en milieux urbain et industriel

— 23 offres des instituts Carnot Eau & Environnement et Clim'adapt pour les entreprises, les collectivités et les acteurs de l'aménagement durable

Découvrez le portfolio



Partenariat France (1) | Carnot Eau & Environnement | 27 septembre 2022

PORTFOLIO

Discover our portfolio of key contacts, and 23 offers of skills and technologies from Carnot Clim'adapt and Carnot Eau & Environnement in terms of rainwater management. These two institutions are committed to developing partnerships between public research and businesses (from SMEs to large groups) or local authorities.



Cerema and businesses answer present for **LES RENDEZ-VOUS CARNOT 2022!**

The fifteenth edition of the “Rendez-vous Carnot” event took place on 12-13 October 2022 at the Espace Champerret venue in Paris. A great many high-value business meetings with companies of all sizes and with a wide range of needs took place over the two days, providing an opportunity to present Institut Carnot Clim’adapt, CeremaLab and, more generally, Cerema’s range of services. Cerema’s partnership research was also underscored during the conferences.

Organised since 2008 by AiCarnot, this annual event has become a must for innovative companies, who make the most of it to gain access to public research. Being able to meet major R&D players means they can push forward their innovation projects and make them happen. All the industrial and technological sectors are present: aerospace, agriculture - agri-food, regional planning, mobility, chemistry and materials, low-carbon energy, environment, industry of the future, sustainable and resilient cities, among others.

With more than 1,100 researchers and experts, this year’s Rendez-vous Carnot once again allowed businesses to benefit from a complete ecosystem of R&D and innovation support: 8,000 meetings were organised for company innovation managers, i.e. an increase of 20% compared with 2021 (source: AiCarnot).

Cerema and Institut Carnot Clim’adapt were actively present throughout the event. Along with the Carnot Clim’adapt team, several Cerema development directors and experts took part in a large number of business meetings with companies.

The underlying goal was to convert these fruitful discussions into research contracts!

Two Cerema experts also gave talks at two high-level conferences:

- **Laurent Arnaud, Director of Cerema’s Sustainable Buildings Department, at the conference on the “Sober and connected sustainable city”**

Five Carnot institutes have joined forces to form an Alliance dedicated to sustainable cities: Carnot Cetim, Carnot Clim’adapt, Carnot Eau & Environnement, Carnot Ingénierie@Lyon and Carnot MECD.

- **Laurent Chevereau, Director of MaaS studies at Cerema, at the conference on “The challenges of Mobility as a Service (MaaS)”**

The conference was an opportunity to present the Carnot consortium working on mobility issues, including Carnot Clim’adapt, IFPEN Transports Energie and Ingénierie@Lyon.

One of the new features of the 2022 event was the **first Carnot Award for Partnership Research**.



Les Rendez-vous Carnot will be back on **18-19 October 2023 at the Lyon Convention Centre**, in the presence of Cerema and its Institut Carnot Clim’adapt!



TO FIND OUT MORE and discover a photo gallery, videos of the conferences and the winners of the Carnot award for partnership research...

Scientific resourcing

Scientific resourcing is one of the three uses of the funding received by Cerema's Institut Carnot Clim'adapt; the other two are professional development, and integration in the Carnot system.

This resourcing is intended to **maintain the institution's scientific excellence, accredited by the Carnot labeling, and anticipate the demands of markets and industry.** The scientific resourcing actions may concern research projects or the acquisition of strategic equipment.

2023 CALL FOR PROJECTS: SEVEN PROJECTS SELECTED

At the end of 2022, Institut Carnot Clim'adapt issued an internal call for scientific resourcing projects.

The applications received were **assessed by the Clim'adapt team and the members of the Strategic Direction Committee, based on a grid containing various criteria:** contribution of the project to Institut Carnot's revenue, compliance with the purpose of Clim'adapt, potential for generating new research contracts with other companies, scientific enrichment, etc. The ranking of the applications was **presented to the Cerema management committee (the Clim'adapt steering committee) for the final selection.**

The share of funding received by Institut Carnot Clim'adapt and allocated to scientific resourcing served to **select and financially support the following projects:**

CLIMATE CHAMBER

Large-scale experimental platform for adapting to climate change

Overview: A 1:1 scale climate testing platform to simulate the effects of climate change on structures in accelerated mode



Cerema research team involved: TEAM, in conjunction with the CER research centre

ALTERNATIVE METHOD TO GAMMA RADIOGRAPHY

Overview: Designing non-destructive testing equipment as an alternative to the current gamma radiography method and thus eliminating the need to use a radioactive source



Research team involved: ENDSUM

SURVET

Green urban surfaces and evapotranspiration

Overview: The development of a direct, continuous method for measuring evapotranspiration suitable for small green urban areas



Research team involved: TEAM

RHOMARIN

Overview: Developing tools to monitor and predict sediment exchange between the Rhône river and adjacent coastal areas



Research team involved: RHITME

WIND TUNNEL

Overview: Finalising the aerodynamic characterisation of the wind tunnel, and designing a turbulence generation device



Research team involved: BPE

MOTORISED RACK

Modernisation of the gonioreflectometer to enable multispectral BRDF measurements

Overview: Adapting the gonioreflectometer used by the STI research team (Clermont-Ferrand branch) for BRDF (Bidirectional Reflectance Distribution Function) measurements of road surfaces



Research teams involved: STI, EL, ENDSUM

SASTRESS

Overview: Developing a low-cost monitoring and warning system for an unstable natural slope based on real-time analysis of the micro-seismic activity generated



Research team involved: GéoCoD

SHRINKAGE-SWELLING OF CLAY SOILS

One detached house in every two is under threat in mainland France



INTERVIEW WITH LAMINE IGHIL AMEUR

researcher in soil mechanics at Cerema

First of all, what is the clay soil shrink-swell phenomenon, and how does it tie in with climate change?

L.I.A. This is a natural shrinkage and swelling phenomenon due to variations in the water content of clay-rich soil under the effect of hydric and cyclic stress influenced by drought and rainfall. This shrink-swell process depends on the mineralogical nature of the clay soil.

With the onset of climate change, France has experienced prolonged droughts in recent years, even in winter. This disturbs the soil, which shrinks even more. Buildings, in particular detached houses with shallow foundations, are severely impacted by shrink-swell. This can lead to structural damage (cracks in the walls, distortion of doors or windows, dislocation of floors and partitions and, in some cases, burst underground pipes).

How does Cerema support local authorities and communities in dealing with these vulnerabilities?

L.I.A. In late 2016, Cerema developed an innovative house humidifier solution dubbed "MACH" (*MAison Confortée par Humidification*) which was tested on the scale of a damaged test house. The aim was to maintain a balanced water status in the subsoil during periods of drought through targeted and controlled rehydration using rainwater, collected and stored beforehand during the wet season.

In 2022, Cerema launched the "MACH+" research project, winner of the Carnot Clim'adapt 2021 call for projects, which aims to leverage artificial intelligence for automatic soil humidification based solely on local weather data. To prepare for this future project, again on a damaged test house, Cerema notably automated the humidification of the clay soil using a 100% in-house digital solution, including on-board systems.

In 2022, Institut Carnot Clim'adapt financed the acquisition of a complete instrumentation centre, comprising a weather station and soil moisture sensors. The aim was to use it in the field in order to collect data and thus understand the shrink-swell phenomenon under the influence of climate change. This mobile centre will be operated on several sites in France for at least one year at each site.

Cerema does not work directly with private individuals, but supports local authorities on these little-known issues concerning the impact of drought on buildings, and the constructive measures needed to protect against it, so that they can help their constituents in the event of a disaster. Indeed, residents often feel helpless when faced with the cost of the work required and the psychological impact resulting from the deterioration of their homes.

Furthermore, without support, victims are unaware of the compensation measures available once the "natural disaster" status has been officially recognised, and the exceptional aid for which they may be eligible in the absence of such recognition.

Commitment to companies

With its Institut Carnot Clim'adapt labeling, Cerema delivers services for private companies to the value of €17 million, or 40% of the institution's own revenues.

Within its six fields of activity, it represents a national, unbiased guarantor via its work for supporting regulations and standardisations, making recommendations, proposing good practices and, where applicable, labelling and certification.

Cerema also acts as a complementary partner to private companies to better meet often complex local, national and international needs. Its expertise is sought within consortia in response to calls for projects and tenders, particular in terms of innovation, given the establishment's specific know-how. Cerema also increasingly supports French companies overseas with a view to promoting and disseminating French expertise.

Via Institut Carnot Clim'adapt, Cerema consolidates its partnership research activities geared towards the socio-economic world. Clim'adapt effectively transmits Cerema's research and innovation to companies of all sizes – start-ups, SMEs, large companies, and construction industry majors who are the establishment's historic partners.

Industrial players turn to Cerema from different perspectives. In fact, with its impact on the climate and, more generally, the environment, industry acts on two levels:

- the production process is often a large consumer of non-renewable resources, while emitting greenhouse gases and other effluents;
- the products manufactured, once implemented, can play a positive role in terms of attenuation and adaptation; accordingly, industrial investments increasingly favour these products.

Thanks to Cerema's diverse expertise and the regional coverage of its sites, it can interact with industrial companies on both levels: reducing the former, and increasing the latter.

Moreover, like any other human activity, industrial activity may also be under threat from climate change. Here too, Cerema's expertise proves to be precious.

Cerema generates
more than €44M
a year in own revenues,

more than **€5M**
of which are contractual revenues
eligible for Carnot funding.

CeremaLab pursues its actions for the benefit of innovative start-ups and SMEs

In 2022-2023, CeremaLab carried out numerous actions intended to identify – and forge ties with – businesses that develop innovative solutions. Throughout this period, CeremaLab consolidated its image as an organisation that listens to start-ups. Meetings took place at trade shows and webinars such as Euromaritime, Innopolis Expo Paris, the Ecotech Rainwater Meeting, Les Rendez-vous Carnot, Meet'Up Greentech, etc. Following an initial contact, the companies were directed to the relevant internal contacts to assess the possibilities for receiving support for their projects.

The start-ups that signed partnership agreements through CeremaLab include Zelin, UAVIA and Urbanloop. By providing its expertise, its technological platforms and its research, development and experimentation capacities to innovative start-ups and SMEs, Cerema is committed to the future, as close as possible to regional projects throughout mainland and overseas France.



TWO HIGHLIGHTS concerning calls for projects

CeremaLab call for projects

“Technical solutions for adapting to climate change in Île-de-France and Normandie”

In the first half of 2023, this call for projects, in collaboration with ESSEC, Normandie Incubation and La Turbine, proved to be a resounding success, with 37 projects submitted. Ten finalists were selected to pitch before a panel of judges, who selected five winners: La Fabrik à Yoops, Mube, Neolitik, Roofscapes and WIND my ROOF. Companies Environment Recycle BTP and Les Bâtimeurs also won a *coup de cœur* (favourite) award. This call for projects served to affirm Cerema’s presence alongside the entrepreneurial and environmental players located in France’s “Seine Valley”.



Focus on TechnoCarbon

Winner of CeremaLab’s first call for projects

Founded in 2018, TechnoCarbon has developed a sustainable, high-performance material – CarbonFibreStone®, a composite of natural stone and carbon fibre, that can replace traditional materials such as reinforced concrete and steel. This innovation offers an effective response to the challenges of building with a reduced carbon footprint. TechnoCarbon has been a Cerema partner since 2021. After winning CeremaLab’s first call for projects, the company went on to sign a Carnot contract in 2022.



“Thanks to Cerema’s expertise, we have made rapid progress towards new uses for our innovative CarbonFibreStone® material.”

Stephan Savarese

TechnoCarbon CEO

The CeremaLab ecosystem now comprises **85** businesses.



TO LEARN MORE about CeremaLab

Institut Carnot Clim'adapt, member of the Carnot network



Research for the benefit of business innovation

Created in 2006, the Carnot label is intended to develop partnership research, i.e. research work carried out by public laboratories in partnership with socio-economic players, mainly companies (from SMEs to large groups), in response to their needs. Representing an important lever for the economy, partnership research encourages business innovation, which in turn fosters competitiveness and growth.

The Carnot label is awarded to public research structures, i.e. "Carnot institutes", that carry out upstream research activities to renew their scientific and technological skills in parallel with a proactive policy of partnership research for the benefit of the socio-economic world.

The ministry in charge of research grants the label to Carnot institutes following a highly selective call for tenders.

The Carnot institutes provide a broad range of skills in response to the R&I needs of companies in most business sectors. In order to draw on their complementarities and leverage synergies for the benefit of their economic partners, they are organised as an **operational network spearheaded by the Association of Carnot institutes (AiCarnot)**.

By keeping in permanent contact with companies, they can understand and **anticipate R&I responses for the various sectors** via pro-active scientific resourcing focused on the need.

The Carnot institutes adopt an approach to continuously improve the **professionalism of their partnership relations**. This approach extends from the first contact to the negotiation and set-up of the project, the supply of deliverables and the gathering of feedback.

 [Read the Carnot Charter:](#)
shared values, serving quality partnership research

 [View the intellectual property policy of the Carnot institutes](#)

KEY FIGURES

39

Carnot institutes organised as a network

20%

of staff from the public research sphere

55%

of R&D financed by French public research companies

11,000

Carnot-business contracts per year,
40% of which with SMEs

To learn more



DID YOU KNOW ?

Carnot institutes like Clim'adapt are **public research structures**, labeled by the French ministry in charge of research, and committed to **developing and conducting their partnership research activity in favour of the innovation of companies – from SMEs to major groups** – and socio-economic players.

The Carnot system is overseen by the French National Research Agency.



Cerema's quality approach

The new AiCarnot board elected on 22 June 2023

Alexandre Bounouh

Director of the Carnot CEA-List
President (Industry of the Future, Digital and Intelligent Systems sector)

Manuel Collet

President of Carnot Ingénierie@Lyon
Vice-President (Engineering sector)

Philippe Lubineau

Director of Carnot Cetim
Vice-President (Industry sector)

Amaury Martin

Director of Carnot Curie Cancer
Vice-President (Health sector)

Philippe Tailhades

Deputy Director of Carnot Chimie Balard Cirimat
Treasurer (Materials sector)

Ahmed Lbath

Director of Carnot LSI
Assistant Treasurer (Digital sector)

Thierry Braine-Bonnaire

Director of Carnot Clim'adapt
Secretary (Environment sector)

Catherine Renard (not present in the photo)

Director of Carnot Qualiment®
Assistant Secretary (Food sector)



"As President of the Association of Carnot Institutes, I will endeavour, with the support of the Board members and permanent staff, to promote the excellence of the Carnot model, broaden our technological offering for the benefit of all industrial players, and work with the public authorities in order to safeguard the resources needed to enhance our impact and the value created by our researchers."

Alexandre Bounouh

President of the Association of Carnot institutes

Cerema's "Coesion" quality system was certified in accordance with the requirements of the NF ISO 9001 standard in November 2021.

It serves to monitor and assess the institution's **strategic objectives**, with a view to continuous improvement, by monitoring the context, being attentive to the environment and managing risks and opportunities.

In November 2022, the **first surveillance audit** notably focused on the Department of Research, Innovation and International activity (DRII). Among the strengths identified, the auditors highlighted the DRII's activities and the organisation of research in conjunction with international partners.

The quality approach is intended to guarantee the **quality of productions**. The six-monthly summary of the satisfaction assessment from September 2022 to February 2023 shows that 98% of customers are satisfied overall with Cerema's products, including 77% who are very satisfied.

Cerema's production quality rests on the quality of its **tests and measurements**; some 250 laboratory tests are carried out in accordance with Cofrac certification (ref. NF EN ISO 17 025).

Right from the start of the Coesion project, a **Corporate Social Responsibility approach** was integrated into the quality system.

Indeed, this is a commitment of Cerema, which seeks to mobilise all staff and to ensure the closest match between its principles and its practices.

A SHARED EXPERIENCE

Carnot quality managers meet once or twice a year to share their experiences and good practices. These meetings also provide an opportunity to open up to other related subjects.

The integration of social responsibility into the quality system prompted a presentation in June 2023 by Cerema's Quality & CSR Mission.



CEREMA'S SCIENTIFIC EXCELLENCE FOR THE BENEFIT OF THE FRENCH ECONOMY AND ITS ADAPTATION TO THE EFFECTS OF CLIMATE CHANGE

BILATERAL CONTRACT RESEARCH FOR:



LOCAL AUTHORITIES
From municipalities to regions



BUSINESSES
From startups to multinationals



CLIMATE CHANGE: ADAPTATION TO ITS EFFECTS, ATTENUATING ITS CAUSES

Circular economy

TRANSITION

Sobriety

FULL-SCALE TESTING

NATURE IN CITIES

Acceptability

Biodiversity

Building, neighbourhood, town and networks

Prototype

Performance and durability

Natural hazards

Urban hydrology

RESILIENCE

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au Cerema” playlist



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La recherche au Cerema

cerema.fr/en [Institut Carnot Clim'adapt](https://www.institut-carnot-clim-adapt.fr/)

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Do you have any questions or needs? Would you like to work with us?

By all means share your scientific challenges with us, we will be delighted to examine them with you.

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