

# Corporate Social Responsability

& ACTIVITY REPORT 2021



**Anticipate the buildings and cities of tomorrow**  
while guiding and securing promoting sustainable  
construction and renovation projects to improve  
quality of life for users.



**Cover images: Study of the wind exposure of Notre-Dame de Paris Cathedral.**

After the Notre-Dame de Paris fire, the public body in charge of its conservation and restoration, which is project manager of the worksite, brought in the CSTB to characterize the wind effects on a simulation of the spire and framework truss of the cathedral. The complementary "digital/experimental" approach developed by the CSTB makes it possible to prepare the measurements better, understand the origin of certain observed effects, and visualize the results while providing solid interpretations in an instructive manner.

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A full-page portrait of Étienne Crépon, a middle-aged man with short, wavy brown hair, wearing a dark navy blue suit, a light blue shirt, and a brown patterned tie. He is standing outdoors with a blurred cityscape in the background. The text is overlaid on the left side of the image.

# Editorial by ÉTIENNE CRÉPON

Chief executive officer  
of the CSTB

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**“In a world that must transform and adapt, the CSTB is also adapting and transforming itself. This transformation is vital to guiding the changes in our environment and meeting the challenges that we will face together.”**

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## The world is evolving

We have known for years that our planet has entered a period of upheaval caused by climate change, the demographic transition of developed countries, and the digital revolution.

The onset of the health crisis in 2020 and the outbreak of war in Ukraine in February 2022, which have disrupted our environment and living conditions, have most importantly made us realize that we live in a deeply unstable world.

Of all these challenges, climate change is arguably the most impactful. The CSTB uses all its skills so that the building industry reduces its carbon impact and limits its use of available resources. At the request of the French State, it is leading the development of the low-carbon road map for the building industry by construction stakeholders through the National Sustainable Building Plan. This work will build on research conducted at the CSTB over many years, and is already bringing about strong initiatives on their part. They demonstrate the collective awareness of the urgency of the issues and the shared conviction that, to address them, a comprehensive approach, taken with open minds, must prevail.

To guide the decarbonization of the building industry, particularly to meet the obligation to reduce the demands on available resources, many stakeholders are embracing the circular economy. Committed to working with them, the CSTB developed green construction assessment for construction products and systems to measure and promote, based on science, their efforts to use recycled materials and design products that can be reused and recycled at the end of their lives. This assessment will be launched by the end of 2022.

Similarly, the development of digital tools and the management of big data provides prospects for transformation and optimization of the building trades. The entire industry is fully aware of this and has begun to grasp the possibilities offered by digital modeling in design, operations and even demolition and recycling of components.

The CSTB cross-referenced several dozen public databases to develop the first national building database, which covers all residential buildings in metropolitan France. Because databases are often incomplete, CSTB researchers developed probabilistic models to supplement them. This national database offers unprecedented opportunities for us to face all the challenges confronting us together, including those posed by climate change and demographic transition.

Because these challenges are major and all efforts and goodwill are welcome, the CSTB is providing this database as open data. And because these challenges are numerous, the CSTB continues to enrich it, alone and with partners, to better anticipate transformations and guide construction stakeholders.

## Building industry coping with the crises

The health crisis has had a major impact on work schedules in the building industry, leading to partial and even complete shutdowns of construction sites.

The war in Ukraine brought supply chain dependencies to the forefront and reminded us of the complexity of building and renovation when it is unclear whether products and systems will be available during construction work and, if they are, how much will they cost.

The fragilities revealed by the two crises are structural. They exist for all industrial activities that have outsourced production in recent years, and are all the more acute for construction products, as the demand for works, particularly renovation, is especially dynamic. This will remain the same in the coming years, given our shared obligation to reduce greenhouse gas emissions in the building industry.

The CSTB remains ready to support the entire industry and identify responses to the challenges that we have and will have to deal with in an unstable world. In particular, it works with industrial companies to measure the impacts on the performance of their products when there are changes in supply. It will review its various assessment and certification protocols to make them more resistant to such changes in the components of products and systems incorporated into final products.

## Overview

Given the importance of planning for the future, the CSTB, in partnership with ADEME (the French Environment and Energy Management Agency) and all stakeholders of the building industry, spent two years conducting forward-looking work to anticipate what the future of construction in France could look like in 2050. It identified four scenarios of the future that depend on the human, material and economic resources available and the territorialization of demand. Some are decidedly dark and will call on us to make painful choices. Others are less so but will require an intense and sustainable effort to adapt our construction and renovation processes, as well as our behavior, so that buildings meet the needs of people.

In a world that must transform and adapt, the CSTB is doing both, as Sylvie Ravalet explains in a comprehensive way and Hervé Charrue shows through research activities. This transformation is vital to guiding the changes in our environment and meeting the challenges that we will face together. Transformation is doubtlessly possible and will happen because it relies on the people who work at the CSTB who are dedicated to their clients and the public interest. More than ever, they are committed to “building the future.” —



## A WORD WITH

# SYLVIE RAVALET

Delegate General Director  
Deputy CEO

### Transforming

To meet the challenges facing our society and support our customers more effectively in an environment that is more uncertain and changing than ever.

In 2021, CSTB teams continued their efforts to modernize our institution through various projects in the 2020–2025 CSTB business plan. Examples include the upgrading of assessments, implementation of the computer-assisted maintenance management (CMM) project, and the redesign of the quality management system. **This transformation is taking place in line with the challenges of the construction sector and follows our CSR approach.** CSR is also addressed through 1 of the 16 programs in the business plan.

Human capital drives all projects, especially transformation projects. **Our future depends on the values the CSTB has embraced throughout its history.** It is also shaped by a shared culture that must adapt to changes in the world around us. Corporate culture is at the core of our business plan through the fifth component, “A corporate culture consistent with our ambitions and values.” It is along those lines that a dedicated Transformation Department was created in 2021.

### Renovating

The CSTB was a successful bidder in the call for projects for the thermal renovation of buildings as part of the French government’s recovery plan; work will take place at the Champs-sur-Marne, Grenoble and Sophia Antipolis sites. All the construction contracts were concluded in 2021, amounting to more than €21 million. They will lead to energy savings of more than 2800 MWh final expected energy per year. This energy renovation work is giving a second life to some of our buildings through comprehensive renovation of their envelopes, including insulation from the outside and inside, change of window frames, and connection to the urban heating network. Summer comfort is also dealt with, supported by greenery and natural ventilation. For the renovation of our headquarters, we are aiming for French High Environmental Quality (HQE) and OsmoZ “building” labels. We are also taking the opportunity to review our ways of working in view of our agreement on teleworking to take advantage of the full potential of the renovated and refurbished buildings.

### Renewing

Always. **Through its research activities and expertise, the CSTB is deepening its knowledge of buildings and cities, their situations, their operations and their multicriteria performance.** The overhaul of research described by Hervé Charrue, CSTB’s Deputy CEO in Charge of Research and Development, is part of our renewal. In this context, the renovation of our buildings is also a testing ground, whether to measure the energy performance of office buildings post upgrade (extension of the SEREINE project) or to assess energy consumption, the sanitary quality of indoor air or ambient conditions through the Health and Energy Quality of Renovations (QSE) protocol.

### Adapting

**Climate change will have a lasting impact on our lives.**

We must prepare for its foreseeable impacts: pressure on water resources, urban heat islands and extreme weather events, to name just a few. We must also look at the changes in use and flexibility of our structures. Controlling climate change encourages us to reduce our consumption of resources and, therefore, optimize the use of our existing buildings and renovate them accordingly. —

“**Transforming. Renovating. Renewing. Adapting. To achieve our ambitions while living by our values.**”



## A WORD WITH

# HERVÉ CHARRUE

Deputy CEO in charge  
of Research and Development

**2020, 2021, 2022: a relentless chain of major events for humanity. And our responses and behavior were and continue to be predictable as we live through the cycle of crises in a situation driven by sensationalism and a whirlwind of information. The sensationalism and information overload, with their varied impacts, should act as a wake-up call, and more. Their coincidence and conjunction under complex circumstances intensify the effects on each and everyone.**

The pandemic intertwines with them. Although it remains with us, it is already being downplayed. What about its enormous effects on people, beyond the globalization of industry, agriculture and the economy? Then a geopolitical crisis, unprecedented in modern times, led to war in Europe and is disrupting daily life around the world. The word “shortage,” which we thought was behind us, reappeared abruptly. Raw materials, supplies, food products and more. All sectors are affected, impacting post-COVID recovery hopes in all countries. The construction sector is doubly affected by the economic slowdown and the invasion of Ukraine. Materials and products are lacking, impeding energy policies, renovation of the building stock and, likewise, the shift toward clean mobility, renewable energies and other priorities. And climate change is revealing itself more every day. Cyclones, heatwaves, torrential rain, floods and droughts one after the other on a scale that never ceases to surprise us.

**“2021 saw the operational implementation of the main R&D topics that characterize them, based on inspiring and holistic storytelling.”**

**When it started overhauling its R&D in 2020, did the CSTB foresee these crises and disaster scenarios?**

Unfortunately, not to this degree of immediacy. Nonetheless, the various issues they raise resonate in the strategic research actions developed in 2020 around an ambition of enabling “Buildings and Neighborhoods that Promote Harmonious Living” in response to the pressing need presented by “*Buildings and Cities Facing Climate Change*”, considering “*Renovation, Innovation and Reliability in the Construction Process*,” and ultimately harnessing the “*Circular Economy and Building Resources*.”

The objectives stem from a multiyear vision that calls on scientific and strategic partners like CNRS, CEA, Inria, Météo France, universities, schools and companies. This has led to the **organization of R&D projects that enable investments to be adapted to the challenges they serve, particularly ongoing changes.**

The circular economy, which has struggled to unite the various stakeholders around concrete solutions, is central to current priorities. The constraints caused by the shortage of materials, deindustrialization and international interdependence should lead to industrialization of secondary raw materials in France and even across Europe, in a much shorter term that was initially suggested by forward studies. Tomorrow, most products will incorporate recycled materials. They will have to comply with fundamental regulations governing energy, the environment, health and other areas, as with current products. But above all, they will have to achieve both technical and economic performance without radically changing construction processes and the durability of structures. This rapid transformation will require R&D and CSTB assessments for characterizing the intrinsic behavior and performance of new products. This will provide better support to industrial companies and contractors as they innovate.

While partnerships are a key to the approach, the CSTB’s own knowledge is another. For too long scattered and compartmentalized, in 2021, CSTB knowledge has become subject to a knowledge management approach for all activities, based on sharing.

**What was learned from 2021?**

Despite the crises and unfortunately often thanks to them, R&D innovates, brings together and forces us to adapt. This is the case for the CSTB and its partners. **Restructured around today’s and tomorrow’s major stakes, it must guide the construction sector in its long term challenges and meet the requirements of the moment, as it did for the pandemic.** —





# 01/

## RESEARCH AT THE CSTB







# AN AMBITION FOR BUILDINGS AND NEIGHBORHOODS THAT PROMOTE HARMONIOUS LIVING

## THREE QUESTIONS FOR SOPHIE MOREAU

Director Strategic Area of Research

**The CSTB decided to set up four strategic research actions from January 1, 2021, to roadmap its research. What were the main stages of this transformation?**

**“This new organization responds to a twofold need: restructure our research in line with societal challenges and review the management of our work for a more systemic and application-oriented approach.”**



All are aware that their work can have a concrete and positive impact on the construction world, and all have the enthusiasm to advance buildings and cities in this century in the face of major challenges.

**The goal of your strategic research action, “Buildings and neighborhoods that promote harmonious living,” is structured around two primary areas of focus: living well in buildings and the neighborhood to live well together. What priority projects have you targeted?**

Once these strategic research actions were determined, we began drafting road maps that show the challenges and set the direction for the next decade. This reset led us to broaden our perspective of the context of buildings and cities in the 21st century and to analyze current and future challenges. We took the time to build a body of references from various and complementary sources: observatories of trends (technical, societal, innovation, foresight), sectoral economic data, ministerial or parliamentary reports, etc... and we also consulted external experts.

**Regarding the road map for “Buildings and neighborhoods that promote harmonious living,” we wanted to expand our historical disciplines by further questioning uses and efficiency.** In addition, some of the topics discussed intersect issues associated with climate change and resource economics and thus with the strategic research actions led by Alexandra Lebert. This is the case, for example, for water management and the place of nature in the city. Similarly, the use of digital technologies affects the industrialization of renovation as well as the development of services for inhabitants. It is therefore with a resolutely systemic vision that we put together these road maps.

**Has this restructuring of research, at the same time, led to changes in the working methods of the research teams?**

Moving from a thematic organization to management by strategic areas required the creation of a new team of project managers. We wanted to create a multidisciplinary team with diverse backgrounds. Thus, we entrusted the management of research projects to people with varied experience, some with doctorates, others with engineering training or master's degrees. Some already have careers at the CSTB, and new employees arrive with academic or experience on the ground that enriches how they approach the subjects together. They are generally young, and include chemists, physicists, economists and architects.

The ultimate objective of our work is to provide responses to policies as well as social and economic stakeholders by improving the understanding of phenomena and offering concrete solutions to the various problems encountered. They thus add to the concerns addressed in Romain Mège's strategic research action on “Renovation, innovation and reliability in the construction process.”

We identified three major priority projects to complete by 2025.

The first questions the integrative approach on the urban scale. The city, which is a complex system, is most often approached by theme, and the stakeholders who “make the city” often feel helpless when faced with the multiplicity of tools, methods and indicators. Our objective is not to have a universal method, as that is unrealistic. Rather, we want to streamline multicriteria approaches and develop metrics for the various parameters relevant to residents and local governments. **Ultimately, it is about providing the designers of cities with useful tools for their diagnostics as well as the operation of neighborhoods.**

The second questions the quality of indoor environments. It aims to use and manage databases that are needed to analyze and understand the causes and prediction of phenomena. It is also a question of refining our measurement methods and **improving multiphysical and interoperable modeling tools** to offer **quality indicators** to project managers and project owners and **promote action**.

The third covers work on the health safety of buildings with respect to chemical and biological agents. It includes a project on understanding the **role of buildings in the spread of pandemics** and therefore aims to develop **protection strategies in the broad sense for building managers**. —





# A PRESSING NEED PRESENTED BY BUILDINGS AND CITIES FACING CLIMATE CHANGE

## THREE QUESTIONS FOR ALEXANDRA LEBERT

Director Strategic Area of Research

### What is the purpose of the four scientific and technical road maps finalized in 2021?

They provide our compass for the coming years. They are based on the contexts and issues considered and are explanatory by showing the positioning of the CSTB and its objectives, as well as the partnerships it considers essential. They address the questions asked by operational stakeholders and those evoked by research. Finally, they describe the objects that CSTB research will have to deliver in the coming years.

These four road maps also go beyond the CSTB's research positioning. **To have an impact on societal issues and reach all stakeholders with whom we work every day, we must involve all our trades. As a force for change, they must make it possible to help us guide, facilitate and scale up.** This means creating knowledge, disseminating it and making reliable alternatives available to stakeholders. Our role is also to ensure that incentives, such as labels or economic tools, are based on robust indicators. Finally, the CSTB is continuing its missions in support of public authorities by serving on standardization committees and in performing the technical work for the preparation of regulations. Our road maps contribute to these various vectors of change, whether they are incentive or coercive.

### To what extent do they reflect the specificity of research at the CSTB?

The CSTB serves as an interface between academic and applied research more for the benefit of operational stakeholders in the construction industry. Our researchers embody this pivotal role: academic backgrounds with doctorates, published work, visibility in scientific circles alongside those working on the ground, desire for short-term results and high capability of precisely identifying the needs of stakeholders.

**“The CSTB's research is at a crossroads: a requirement for scientific rigor coupled with a desire for operational effectiveness and rapid and shared implementation.”**

### For climate change, your Strategic Research Action is structured around two areas of focus: mitigation and adaptation. What are the first actions to take?

**The urgent need is to decarbonize the building sector in its construction, operational and renovation phases.** As an accelerator of our research work, the French State entrusted the CSTB with the co-chair for the development of the low-carbon future road map for the construction value chain. Planned under Article 301 of the Climate and Resilience Act, it will be established in concert with all construction stakeholders in the course of 2022. **Precisely understanding our collective responsibility in terms of greenhouse gas emissions, quantifying low-carbon solutions, as well as the investment needs to prioritize them, and constructing scenarios at the scale of building stocks and territories will be our focus of work.** This decarbonization will involve massive renovation of the building stock. The challenge therefore strongly interacts with the strategic research action led by Romain Mège on “Renovation, innovation and reliability in the construction process.”



**Regarding adaptation to the effects of climate change, we chose to focus on controlling urban heat islands (UHIs) and the availability of water resources.** The challenge is to model microclimates, water cycle impacts and the UHI effect at the city level, taking into account data available on the ground and the future climate. Thus, to enable local authorities to diagnose and lead concrete policies for development, mobility and building stock renovation taking into account the well-being and health of their residents, we are working to make modeling fast and more reliable in partnership with the various stakeholders in the fields concerned based on more educational feedback. UHIs are at the junction between the Strategic Research

Actions “Buildings and neighborhoods that promote harmonious living,” led by Sophie Moreau, and “Buildings and cities facing climate change.” We set up the frameworks for objectively assessing existing solutions and guiding innovations by analyzing their impacts. The aim is to enable stakeholders to make informed decisions, offering them the ability to compare several scenarios and solutions to optimize their projects. Finally, because elevated temperatures represent a health risk to everyone, we are continuing our work on characterizing comfort so that the designers of buildings can construct and renovate with a goal of reducing the vulnerability of the building stock to climate change. —





# PROJECTS FOCUSING ON RENOVATION, INNOVATION AND RELIABILITY IN THE CONSTRUCTION PROCESS

## THREE QUESTIONS FOR ROMAIN MÈGE

Director Strategic Area of Research

### What are the means and drivers we need to expand renovation massively?

At the macroeconomic level, **it is essential, first, to have good knowledge of the existing building stock to know where we stand, measure the progress made, and determine the work still needed.**

Via the French national buildings database (BDNB), the CSTB now has an updated picture every year, or even several times a year for some data, of the entire metropolitan residential building stock.

Resulting from cross-referencing several dozen public databases, it makes it possible to view all the characteristics of a building (year of construction, configuration, energy consumption observed or simulated, exposure to natural hazards, surface area of the property, attractiveness, etc.). CSTB research has contributed to the development of an artificial intelligence-based tool that fills in the missing data in a given database, thus providing a comprehensive view of building stock.

It will be a valuable and indispensable tool tomorrow to **make renovation strategies more reliable at the level of a territory or building stock of a real estate company or housing operator.**

This fundamental asset has a cross-cutting purpose and serves as an evidence base for other strategic research actions, whether it is the one led by Sophie Moreau on “Buildings and neighborhoods that promote harmonious living” or the two led by Alexandra Lebert on “Buildings and cities facing climate change” and “Circular economy and building resources.”

While the tool has only been operational since early 2022, several housing operators and local authorities have asked to use it to make their strategies more reliable.

### What about the project scale?

Renovation needs and performance and resource saving requirements are enormous for adapting buildings to climate change and meeting the challenges of demographic transition and changing uses. For common products, the knowledge available enables project management and consulting firms to assess the contribution of products to the performance of the works in which they will be incorporated.

**But the stakes and volumes of renovation are such that it will also be necessary for all stakeholders to grasp the innovations that will be used by industrial companies, project owners and project managers.**

In order for them to do so with confidence and make the right choices, it is important to know how to measure the performance of products and their impacts on the building in which they will be integrated.

### Specifically, how will these objectives guide your research projects in the coming years?

**“In order for stakeholders to stop their planning and implement it, this first requires the design of multicriteria assessment protocols for new products as well as systems and materials that, having fallen into disuse, do not have the necessary scientific and technical documentation.”**



A research project on multicriteria assessments (thermal, mechanical, fire, durability, acoustic, health, environmental) aims to establish, by 2025, the scientific basis for assessing construction products comprehensively. Studies include the behavior of conventional building materials (masonry, concrete), biosourced insulation materials and low-carbon wood and concrete products, which are increasingly used in sustainable development.

The project owner must also be able, before construction work, to measure the consequences of a choice and, during construction work, to ensure that the project runs smoothly.

One of our lines of research consists in simply performing multiple and varied simulations using the same digital model to combine the advances of building information modeling (BIM) with the results of scientific work conducted on the comfort and energy and environmental performance of construction products and systems.

Another line of research takes place later in the life of the building. It aims to facilitate the use of BIM tools for construction project monitoring, the operational phase and even demolition and recycling of components and materials. **Our work is both theoretical and applied, taking the form of “research action” and guiding local authorities and property owners in acquiring digital tools and discovering all the opportunities they can provide.** —



RESEARCH AT THE CSTB

# TOOLS FOR CIRCULAR ECONOMY AND BUILDING RESOURCES

## THREE QUESTIONS FOR ALEXANDRA LEBERT

Director Strategic Area of Research

**Optimizing the use of resources is essential to protect the environment and biodiversity. In this context, the desire of the CSTB is to bring together the stakeholders in the construction sector around the circular economy. What are the means at its disposal to ramp up this process?**

On June 1, 2022, the CSTB established a new operational Economy and Resources Department consisting of research engineers, statisticians and economists.

**The circular economy now has a meaningful place and serves as a common ground between the various CSTB trades.**

We are strengthening our research arm by establishing specific partnerships with the academic world. At the same time, we are consolidating our link with the operational world by continuing our collaborations with stakeholders who want to put the circular economy at the center of their strategies.

Issues related to energy, non-energy and water resources are also major areas of focus for us, so the CSTB created a new Water Department in January 2022. The Energy & Environment Department has also grown. Today, it brings together more than 100 employees.

**Incorporating the circular economy at the design stage of products, structures and development projects is an indispensable lever to reduce environmental impacts and limit material flows. What are the solutions envisaged for existing buildings?**

The most effective way to avoid waste generation is to optimize our existing building stock and, in parallel, for new construction, to have optimized design and resource and construction work management. **Extending life expectancy and renovation are the primary drivers of the circular economy.** This is why one of our strategic research actions, led by Romain Mège, is dedicated to renovation. However, when demolition is chosen, the objective is to minimize waste generation. It is therefore necessary to **demolish structures selectively and add value to their components through reuse and recycling.** Pathways exist for making the most of our secondary resources.



**Guiding, organizing and drawing attention to these solutions are some of the objectives of the CSTB.** This involves the dissemination of knowledge, the emergence of quality indices (labels, methods) and the provision of tools that improve the safety of the practices stakeholders use. **Identifying and mitigating health risks and countering deteriorated performance to make reuse, material recovery and habitat densification safer are some of our main focuses.**

**What research projects are you currently working on?**

To enable stakeholders to predict future material flows and greatly expand or even industrialize access to secondary raw materials – today considered a widespread resource – the CSTB has developed the BTP Flux tool. It is based on a territorial analysis methodology that models the existing stock, material product flows and waste volumes related to demolition and renovation and assesses the resource needs for new construction and renovation. The model is based on cross-referencing databases for the statistical description of the building stock and on modeling their materials. This tool uses the French national buildings database (BDNB), and has been tested by ADEME (the French Environment and Energy Management Agency) in the Paris region. Several collaborative projects, including theses, are contributing to its development, validation and reliability. Assessment by trade (circular economy, asbestos, environmental impacts) is thus associated with data analysts and geographic information system (GIS) specialists. BTP Flux will be enriched later this year to assess the likelihood of the presence of asbestos and lead. We are at a crossroads with other strategic research actions: “Buildings and neighborhoods to live well together,” led by Sophie Moreau, and “Circular economy and building resources.” To ensure that reuse plays its full role, the CSTB also started drafting methodological guides setting out the stages of diagnosis to perform after refitting. **The challenge is to be able to certify the suitability of a component for use in another structure.** By product family, and for each area of application tested, the methods for assessing performance are determined collaboratively. —





02/

# THE CSTB'S SOCIETAL COMMITMENT

16 — TAKING ACTION FOR OUR PLANET AND FUTURE GENERATIONS

26 — NURTURING HUMAN CAPITAL AND PUTTING IT CENTER STAGE

36 — ASSERTING OURSELVES AS AN INDEPENDENT AND ETHICAL GROUP









# TAKING

## ACTION FOR OUR PLANET AND FUTURE GENERATIONS

- 18 — Creating and sharing knowledge
- 20 — Guiding innovation
- 22 — Increasing safety and highlighting performance
- 24 — In-house CSTB activities



## THE PERSPECTIVE OF

# JULIEN HANS

CSTB Grenoble Facility Manager  
Director of Energy & Environment

**“We can no longer design buildings today without planning for their complete disassembly tomorrow. It is no longer sustainable to continue demolishing structures with wrecking balls, jackhammers and dynamite, which also emit greenhouse gases.”**

**E**nvironmental transformations and the consequences of global warming are now accelerating. Every day, we see their direct impacts on our living conditions and built environment.

In this context, the CSTB is demonstrating its environmental commitment through its activities and research in response to climate change and the need to reduce greenhouse-gas emissions.

The operational breakdown of its work resulted in the entry into force on January 1, 2022, of the French environmental regulation (RE2020), which includes the concept of summer comfort during heatwaves and is based on life cycle analysis. While maintaining and strengthening the energy component of the French thermal regulation (RT2012), it introduces an environmental component by putting new construction on the path to carbon neutrality.

In this way, RE2020 is a radical change in how we construct buildings.

And this is just the start. Regardless of how energy- and environmentally-efficient a building may be, it is crucial to think about it as part of the urban system as a whole. Our neighborhoods, urban development projects and cities must follow a low-carbon path. In addition, we must now consider other environmental issues, including natural resource depletion, waste generation, water, air and soil pollution, and biodiversity loss. We also need to find the keys to performing widespread renovation of the existing building stock, whose energy gains must be measured and guaranteed.

The CSTB is guiding these energy and environmental transitions by keeping a step ahead of these challenges. As part of its missions, it promotes the development of the circular economy, encouraging ease of disassembly and reuse of materials and construction systems. To this effect, its teams collect data and develop innovative decision-support simulation tools, methods and indicators for products, buildings and territories, which they provide to public authorities and all stakeholders in construction and development. The French national buildings database (BDNB), that contains information on the existing building stock, and SEREINE methods, to measure real renovation performance, demonstrate the concrete solutions we offer to encourage the massification of renovation.

Long limited to research and expertise, this work increasingly enriches the other activities of the CSTB, particularly assessment and certification. This will intensify in the years ahead.

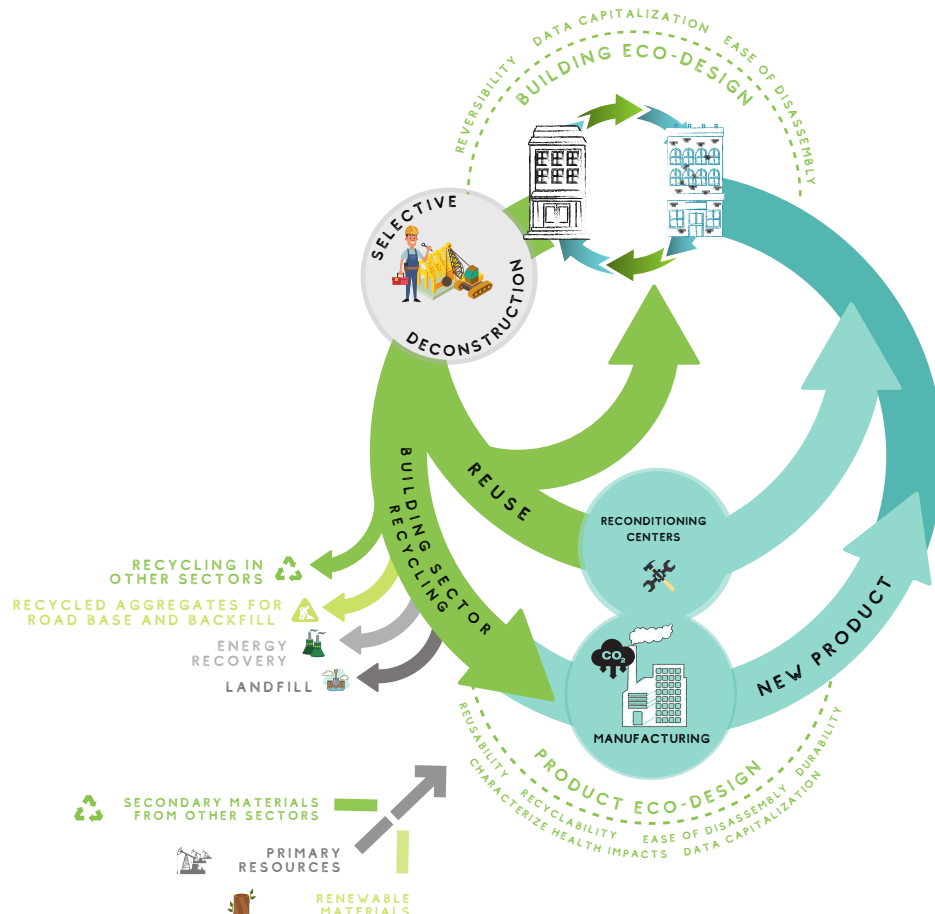
The CSTB's commitment to the environment also extends internally to the life of its facilities. As part of the French government's recovery plan, the CSTB is making itself an example by testing the tools developed through its research (SEREINE, the Health and Energy Quality of Renovations (QSE) project, etc.) on its own renovation projects. —





## CREATING AND SHARING KNOWLEDGE

# WAYS TO DEVELOP THE CIRCULAR ECONOMY



Demolition waste is now a resource. To expand its use in construction, the CSTB is stepping up its initiatives to develop new sectors and disseminate best practice to stakeholders.

*“2022 will mark a turning point in the construction sector for the circular economy and the management of demolition products, equipment, materials and waste (PEMD),” predicts Sylvain Laurenceau, Director of Economy and Resources. In addition to the new PEMD diagnosis, the extended producer responsibility (EPR) regulatory process will become effective in the construction industry on January 1, 2023.*

**Waste becomes a resource, and the French regulatory “Waste” diagnosis becomes the PEMD diagnosis, which applies to PEMD from both demolition and renovation of buildings.** Professionals must reinforce their practices of selective demolition, reuse and recycling.

## PEMD platform

The CSTB is central to the new regulatory process and has developed a **digital platform** at the request of the French Ministry of Ecological Transition to promote collaboration between stakeholders and facilitate their procedures.

For major demolition and rehabilitation operations involving more than 1,000 m<sup>2</sup>, **this platform enables project owners to comply with their regulatory obligations**, such as sending information from PEMD diagnoses during the design phase and taking stock of PEMD monitoring data at the end of construction or renovation.

When project owners receive feedback, their interest in completing the diagnoses in this platform will increase. It will also make it easier for public authorities to enforce the regulations.

Finally, by using the French National Buildings Database (BDNB), the platform will highlight PEMD sources in the value chains, which will enable project owners to act in advance to optimize the use of resources.



Complementing the PEMD platform, the interactive asbestos management tracking tool (ORIGAMI) was created via a research program entrusted to the CSTB as part of the French Asbestos Research and Development Plan (PRDA) launched in 2015. This online tool estimates the likelihood of the presence of asbestos products in buildings.

Some of ORIGAMI's work is also leveraged in a database characterizing existing products (weight, potential for reuse or recycling, possible presence of hazardous substances, etc.) under development at the CSTB.

## Guide to selective demolition

Selective demolition enables better use of demolition products, equipment, materials and waste (PEMD) generated during construction, thanks to reuse and recycling. The procedure must apply to the successive stages of construction throughout the entire life cycle of a building and involve all stakeholders.

**To steer the sector along this virtuous path, the CSTB and the Orée nonprofit organization published the guide, "How to add more value and improve demolition in the building industry."** It provides a practical and operational guide to the wide dissemination of best practices and is downloadable for free.

## Promoting the reuse of demolition products

To broaden the reuse of demolition products, the CSTB offers a four-step approach:

- ▶ **Identification of the most suitable product families** for reuse;
- ▶ **Development of guides** specifying the conditions for substantiating suitability for use;
- ▶ **Promotion of these guides;**
- ▶ **Build on feed-back.**

During the year, research was conducted on several product families. The aim is to harmonize stakeholders' practices and assess product performance to ensure reuse. Eight guides were created in 2020, new ones are in preparation and 36 datasheets are now available.

To support the sector in its upskilling, the CSTB has also developed digital tools and training courses to optimize the demolition phase, which plays a key role in waste recovery. **In 2021, training was offered for the European professional title certifying level 5 PEMD Diagnosticians (French Bac +2, or 2 years higher education after secondary school), in partnership with the Union of Demolition, Cleanup and Recycling Companies (SEDDRe) and the consulting and design firm Recovering.** Other training courses are for project owners and project managers.

### Find out more



Product, Equipment, Material and Waste diagnosis in 30 seconds with Sylvain Laurenceau, Economy and Resources Manager



See the guide, "Building industry: how to add value and demolish?"



Register for the training course, "Become a Product, Equipment, Materials and Waste Analyst"



## FORWARD-LOOKING APPROACH: A TOOLKIT TO PLAN FOR THE FUTURE OF BUILDINGS

**Climate change, demographic transition, development of new uses and technological shifts: faced with the major challenges that will fundamentally transform demand and supply of real estate in coming years, ADEME (the French Environment and Energy Management Agency) and the CSTB have conducted forward-looking work to get ready for what's to come in construction and real estate through 2050.**

At the end of 2021, this work, carried out in conjunction with sector stakeholders over two years, resulted in:

- ▶ Identification and analysis of 22 key factors that will shape the future of construction and real estate;
- ▶ The design of a forecasting tool based on 73 contrasting projections of change;
- ▶ The development of four scenarios for a more or less forgiving future, with sources of realignment as well as disparities ("Hard to do everything," "Building as a service," "Realignment," "Shortages").

All construction and real estate stakeholders can use each tool independently depending on their needs and interests. If necessary, the CSTB can provide personalized support to teams as part of workshops designed to foster strategic thinking.

The CSTB will continue its forward-looking work in 2022. *"Two initiatives will be launched: quantitative forward-looking work based on the results of this first step and a qualitative prospective study involving a new expert committee focusing on the consumption of resources in the real estate and construction sectors from now until 2040,"* says Jérémy El Beze, Director of Forward Planning in the Economy and Resources Department.

### Find out more



The forward-looking approach, "Let's imagine the buildings of tomorrow"



## GUIDING INNOVATION

# RÉNOSTANDARD :

## integral and innovative solutions for renovating private homes

**RénoStandard was created as part of the PROFEEL<sup>1</sup> program and makes it possible to develop and test innovative methods and tools for guiding and optimizing the development of comprehensive renovation for “standardized” private homes.**

RénoStandard comprises a set of comprehensive renovation reference projects applicable to a large number of private homes and based on innovative technical solutions at the lot and interface scales. In addition, to promote the expansion of renovation, new digital tools for cross-functional diagnosis and visualization were developed for professionals who work with homeowners.

### 11 innovative solutions for comprehensive renovation

Nine consortiums designed 11 standard, comprehensive renovation solutions optimized for 11 types of private homes widely represented regionally and nationally. **The construction and architectural characteristics of these types of targeted homes are sufficiently close to enable renovation designed and performed by adapting efficient and replicable reference projects.**

Guided by CSTB experts in a dozen technical areas - special insulation systems, structures, humidity, weatherproofing, fire safety, comfort and carbon, to name just a few - this collaborative effort led to the emergence of many innovations, from the scale of the component to that of the building, and their use (prefabricated ETICS solutions for each project, interface treatment, new implementations of insulation materials, use of new materials, architectural requalifications and bioclimatic approaches).

### A protocol to identify housing qualities and defects

The cross-functional diagnostic protocol is a part of the RénoStandard tools. It makes it possible to analyze housing units in their entirety and identify qualities and defects, particularly in terms of comfort and sanitary quality. Based on observation and discussions with occupants, **it takes less than half a day on-site for a professional using the web interface developed for RénoStandard.** This protocol is intended for specialists in diagnosis, support and consulting in energy renovation of private homes.



<sup>1</sup> PROFEEL, addresses nine challenges for energy renovation and was the winner of the French state's Energy Savings Certificate (CEE) call for projects in 2019





## An approach tested with homeowners

The RénoStandard approach also guides homeowners toward comprehensive renovation tested with a hundred homeowners with varied profiles in 25 French departments. Urbanis, the project partner in charge of implementing the RénoStandard methodology on the territory, met with them to discuss their renovation projects and diagnose their homes with respect to the 11 types used in the RénoStandard.

Households are showing **great interest in the cross-functional diagnostic protocol, particularly for its ability to establish links between the discomfort felt by occupants and the sources of discomfort identified by professionals.** In addition, the possibility of presenting standard renovation projects using a dedicated digital tool reassures homeowners and helps them plan for comprehensive energy renovation. Finally, the combination of a personalized approach and a comprehensive and structured technical approach to renovation meets an existing need. **This protocol is an effective and innovative tool for decision support.**

The RénoStandard approach and its digital tools provide advice and support to professionals for recording and compiling the standardised characteristics and peculiarities of buildings, uncovering needs not previously known to households and responding to them by offering efficient and tailored work.

Finally, it provides a medium for demonstrating the benefit of taking a comprehensive energy renovation approach.

The RénoStandard system will continue until 2025 as part of PROFEEL 2 through the RESTORE project. Comprehensive renovation projects serving as references will be carried out with the best RénoStandard solutions. Their implementation and performance will be assessed exhaustively under real conditions using dedicated protocols for monitoring worksites and post-renovation performance, including SERENE and QSE (quality, safety and environment). **RESTORE will use the practical experience to determine and provide renovation professionals with integral technical, organizational and commercial offerings for deploying RénoStandard solutions on a large scale. These offerings will also include new families of technical solutions developed as part of the project.** —

### Find out more



RénoStandard:  
a project from  
the PROFEEL program



Discover the 11 projects  
for comprehensive  
renovation

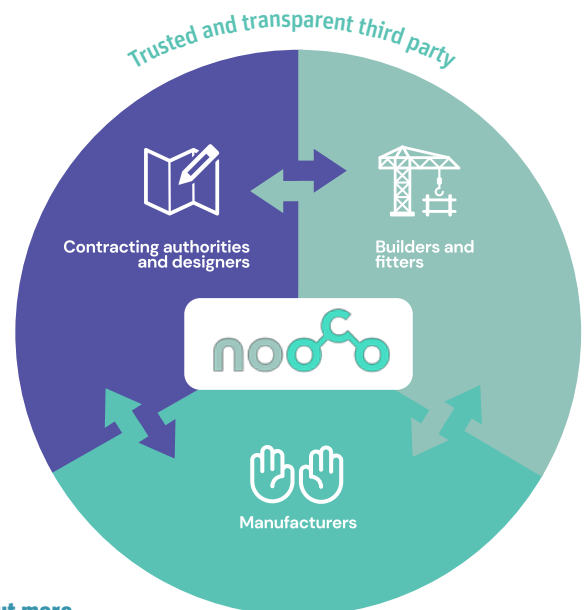
## NOOCO ENHANCES THE VALUE OF LOW ENVIRONMENTAL IMPACT CONSTRUCTION SOLUTIONS

**In 2021, the CSTB'Lab, the Group's start-up accelerator, continued supporting new innovative companies that develop solutions for the construction sector and environmental and energy transitions. We focus here on Nooco, a company that adds value to products and systems that have low environmental impact by addressing their most pivotal elements.**

The online software-as-a-service (SaaS) platform developed by Nooco measures the environmental impact of a construction project quickly, in a reliable and transparent manner, in accordance with the French environmental regulation (RE2020). With its ergonomics optimized for operational problems, it provides environmental indicators adapted to the decision-making of the various stakeholders in construction projects.

It makes it possible to compare design options at the scale of a structure and optimize the choice of materials and equipment at the scale of a product, to control its environmental impact in accordance with technical design constraints.

As Marine Vesson, Manager of the Environment Division in the Energy & Environment Department of the CSTB and sponsor of this start-up, explains: *"With a simple, fun and effective solution, Nooco encourages all stakeholders to learn more about their scopes of action and what's needed to expand low-carbon construction."*



### Find out more



Discover the CSTB'  
Lab startups



8 new startups join  
the CSTB'Lab



## INCREASING SAFETY AND HIGHLIGHTING PERFORMANCE

# PIPING SYSTEMS AND NETWORKS: from R&D to guaranteeing the performance of products and structures

**The CSTB supports piping system manufacturers by developing protocols and test benches to guarantee the quality of their products.**

Whether drinking water supply, wastewater drainage or indoor drinking water pipes, manufacturers of piping systems face the same challenges: how to **guarantee the performance of products and the durability of installed and renovated structures.**

The CSTB collaborates with sector professionals to conduct R&D projects that establish protocols, standards and other tools for assessing the performance of traditional and innovative water supply and sanitation products, systems and structures.

### Classification of resistance to disinfection systems

Disinfection systems, particularly in the indoor piping of health facilities, are essential to ensure the sanitary quality of the water distributed. The increasing use of polymeric and elastomer materials in drinking water supply systems (piping, sanitary tapware, fixtures, etc.) raises the question of their compatibility with disinfection systems. For facility operators, this is an issue for the long-term safety of supply systems.

**With the support of stakeholders in the QB08 label ("Water supply or drainage piping"), the CSTB developed a test bench for piping systems. The scientific data from chemical aging tests now makes it possible for the CSTB to develop a specific classification measuring the resistance of products to disinfection systems. QB08-certified products can be assessed based on this classification in the same way as sanitary tapware for medical settings, which has received the "M" rating associated with NF 077-15 certification since 2019.**

### Recycled materials for drainage systems

To reduce the environmental footprint of drainage systems, the use of recycled material in piping systems is becoming more widespread. While this practice is nothing new, it is not proven for all materials. The CSTB therefore consulted with industrial companies in the related sectors and launched **a research project to measure the durability of piping systems based on the recycled material used to manufacture them and their proportion in the aggressive sanitation environment.** Objective: be able to make a meaningful comparison of products intended for this use without compromising on life expectancy, which must be longer than the conventional 50 years.

### Ensuring a longer life expectancy for piping systems

**The replacement of public drainage and supply systems is a major challenge for local authorities and water agencies in most of France.** *"Indeed, the replacement rate of these systems is about 0.6% to 0.8% a year in metropolitan France,"* says Anthony Couzinet, Head of Networks and Outdoor Building Systems at the CSTB. *"As it stands, it would take more than 150 years to replace all the networks, while their theoretical life expectancy is 50 years."*

In addition, the conventional 50-year life expectancy in standards does not allow products to be compared, even though some might have greater longevity. For example, cast-iron supply systems that have been in place for over 100 years can remain in good shape, depending on certain conditions. Steering local authorities to quality products to ensure better durability is therefore an objective for the CSTB. **It conducts research using special tests to define extrapolation methods that can extend the life expectancy of structures to 100 years.**



► Wastewater collection system under Technical Appraisal



## Assessing an aging supply system

Half of water supply systems date from the 1970s. **Local authorities that use them sometimes uncover defects, especially during maintenance operations. They then seek the CSTB's expertise to get answers.**

In 2021, the CSTB worked with "Nantes Métropole" to find an explanation for the appearance of colored water among users. Its experts created a defect observatory and were able to draw up a cause tree chart of the phenomena. They classified and identified the most likely causes and then recommended a targeted monitoring and maintenance plan to optimize annual operations in critical areas. This comprehensive, scientific approach enabled "Nantes Métropole" to get a response that is truly adapted to its needs.

## Quality labels to meet evolving industry standards

The six sections of the general technical specifications (CCTG) applicable to public contracts for civil engineering projects relating to the water sector, which date from 2003, were revised to include developments in best practice, standards and regulations. They were published on October 7, 2021.

**Sections 70-1 and 71, which concern the supply, installation and rehabilitation of water supply piping systems, provide public procurement stakeholders with a clear contractual framework to help them award contracts.** Public funding for drainage and drinking water supply systems requires contract holders to maintain the declared performance of their products. When a product is used, it must comply with one or more standards, and this compliance must be proven.

The certifications offered by the CSTB—QB09, NF442, NF055 and NF390 for new piping systems and trenchless renovation techniques using pipe lining—enable local authorities to ascertain the quality of the products installed. An NF- or QB-certified product meets the requirements in all respects, which are continuously verified by a third-party body at the production or implementation site. **Without this marking, the public buyer must perform on-site checks when products are received.** —



## SEREINE, A GROUNDBREAKING SOLUTION FOR ASSESSING THE REAL ENERGY PERFORMANCE OF BUILDINGS

**The CSTB serves as technical coordinator of the SEREINE project - led by the Construction Quality Agency (AQC) - one of nine projects in the PROFEEL program, which aims to advance the measurement of energy performance of buildings after renovation. SEREINE makes it possible to develop operational measurement protocols and mechanisms that meet the real-world needs of stakeholders on the ground and, more specifically, the requirements of building rehabilitation.**



► Installation of sensors

After three years of work, the SEREINE project, which was completed at the end of 2021, has met its objectives. To measure the quality of renovation and construction works and gains in energy efficiency, SEREINE has successfully developed an unprecedented solution for new and renovated private homes. It includes a method for measuring the thermal performance of the construction envelope in record time and an application for assessing the energy performance of all heating, air conditioning, domestic hot water, ventilation and lighting systems.

**The encouraging results led to the project's extension for three years as part of PROFEEL 2 (2022–2024). The objective is to optimize the measurement method and protocol implemented.** The solution will be tested in 240 private homes thanks to 50 operators who will be recruited as part of a dedicated call for expression of interest. A variant of the solution applicable to apartment buildings will also be developed.

### Find out more



SEREINE:  
a project from the PROFEEL program





## CSTB IN-HOUSE ACTIVITIES

# RECOVERY PLAN:

## construction sites at the CSTB



► Rehabilitation of a building on the Marne-la-Vallée site

### As part of the French State's recovery plan for energy renovation of public buildings, the CSTB has begun preparing construction work on three of its premises.

Three CSTB sites - Champs-sur-Marne, Grenoble and Sophia Antipolis - were selected in response to the *France Relance* recovery plan call for projects launched in 2020. Thanks to this major energy renovation program, with €16 million in funding from the French State, **the CSTB will be able to reduce its greenhouse gas emissions substantially and improve the quality of work life for its employees, as well as the reception of its customers. This work provides the CSTB with a testing ground for its research activities and the tools developed by its teams.**

The aim is to reduce energy consumption - particularly for heating costs - and carbon emissions. The projected gains amount to 2800 MWh final expected energy per year. Works were prepared for energy improvement, major multicriteria rehabilitation, construction of efficient reception buildings and connection to the local urban heating network (GÉOMARNE).

In Champs-sur-Marne, the CSTB will connect to the heating network powered by geothermal heat rolling out in the city. In addition, the administrative building will be completely restructured to transform it into the headquarters of the establishment. Several other office buildings will be renovated to improve their energy performance. Some highly inefficient buildings will be demolished. Finally, it is planned to completely review access to the site, with the separation of access for employees and visitors (including safe pedestrian and bicycle access) and that for deliveries. Two separate reception buildings will be built.

In Grenoble, the work will focus on the renovation of the main building and a research center. They will complete work in 2021 to transfer the glazing test laboratory to this site.

In Sophia Antipolis, the work involves replacing all the windows, French windows and lighting fixtures in the three buildings.

### In 2021, the teams on the premises concerned became deeply involved in the design and scheduling phase of the projects.

The studies made it possible to obtain planning authorization, verify the appropriateness of the solutions considered, and consult with and select contractors. Temporary relocation was prepared to take place at the end of 2021. Some preparatory work was also carried out at the end of the year to allow construction work to start in early 2022.



## Testing ground

**This work, as part of the Recovery Plan, also gives the CSTB the opportunity to enhance its research activities and test the tools developed by its teams.** Several tools have already been used in Grenoble and Champs-sur-Marne. For these two sites, a life cycle assessment (LCA) was performed in the design phase on the building most affected by the works. This calculation consists in assessing the environmental impacts of a structure over its entire life cycle, and helps guide design choices.

SEREINE, a protocol for assessing the real energy performance of buildings, developed under the PROFEEL program, was also used. Its objective is to measure the energy performance of buildings after renovation work, but the teams wanted to use one of the structures as a test building to perform experimental measurements of the actual thermal performance of the envelope, before the work was carried out. *“It was valuable for the operational teams to perform experiments in the services sector, given that SEREINE was originally developed for residential buildings,”* says Solène Huchet, Project Leader at CSTB Grenoble. All measurements were taken the week before Christmas when the building was empty and the difference between indoor and outdoor temperatures was significant. An airtightness test on two offices was performed in parallel.

Another tool managed by the CSTB within the PROFEEL program, the “Health and Energy Quality of Renovations” (QSE) protocol, is also being tested in Grenoble and Champs-sur-Marne to assess energy consumption, indoor air quality and ambient conditions. Measurements of the indoor environment (temperature, humidity, air quality) were taken before work began.

A questionnaire was also sent to users of the premises to determine the hours of occupancy and their habits and assess their daily comfort. The same protocol will be used once the renovation work is completed.

## Upskilling

This work will be completed in 2023 and will give the Energy & Environment, Building Envelope, and Windows and Glazing departments the opportunity to consolidate their field experience. *“Our engineers and researchers don’t have the opportunity to observe renovation projects on a daily basis,”* comments Caroline Bouteloup, Manager of the Rehabilitation and Building Stock Management Division at the CSTB. *“Having them verify product implementation and manage critical points will be a very rewarding experience.”*

Also involved, the Information Technology Department has created a digital twin at the Sophia Antipolis site to model all the buildings and facilitate the management of equipment, such as the electrical network, electric cabinets and fire extinguishers. —

## CIVIC ACTION AND SCIENTIFIC RESEARCH

**CSTB Nantes, in association with ESAT Tournière Services (French organizations that help disabled people back into work) in Carquefou, France, has created a laundry service at AQUASIM, its major research facility for the sustainable management of water in buildings.**

**This launderette is managed by two ESAT workers and enables the CSTB to recover the wastewater generated by washing machines and use it in its experimental test benches dedicated to the reuse of gray water in buildings.**

To provide this raw material for studies conducted by the AQUASIM team, the launderette is open three days a week to CSTB staff. Employees can bring their own clothes for washing, drying and ironing. The launderette also takes care of all CSTB professional clothing, as well as the professional laundry of the Technical Center for Mechanical Industry (CETIM) under a partnership.

This initiative, which also aims to promote the inclusion of people with disabilities, is complemented by the recovery of the gray water from the four showers installed in the AQUASIM building available to CSTB staff.

**In 2021, 37 employees used the laundry services regularly. In total, 3,000 kg of laundry has been washed, amounting to 18,000 liters of water collected.**



**Find out more**



Sustainable water management with AQUASIM





# NURTURING

## HUMAN CAPITAL AND PUTTING IT CENTER STAGE

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## THE PERSPECTIVE OF

# / RÉMI LETEINTURIER

Director of Human Resources

**“The changes in our environment require a thorough review of our practices to preserve the link between teams and our corporate culture. In 2021, internal communication was therefore strengthened to maintain an ongoing dialog.”**

**I**n line with its goals, one of the priorities of the CSTB is to contribute to improving well-being, comfort and uses in buildings and neighborhoods to promote harmonious living.

Buildings are at the core of a complex ecosystem formed by the neighborhood and city, and must provide safety and comfort adapted to the needs of users. The challenge for the CSTB is to offer a continuum of “harmonious living,” from the private sphere to the public space.

In 2021, the CSTB again worked on how best to achieve this goal: development of its expertise in the City Information Model (CIM) (digital tool for urban planning); the rollout of projects such as the “Health and Energy Quality of Renovations” (QSE – aimed at improving air quality and indoor comfort) and Ecco Dom (which aims to reduce energy consumption in overseas departments and regions while maintaining summer comfort); its in-depth research on the spread of respiratory viruses like SARS-CoV-2 in indoor spaces; and the involvement of its CERTIVEA subsidiary in the Homes4Life program, dedicated to the design of age-friendly housing. This multicriteria approach to the challenges facing buildings and their surroundings is one of the strengths of the CSTB, alone able to bring together all the skills needed for a scientific approach to construction as a whole.

The CSTB teams and the multidisciplinary skills they combine provide the foundation for its scientific and technical excellence, which serve public authorities and all the stakeholders involved in construction and urban development. Honing these skills is therefore a major challenge for the CSTB, which builds its relationship with its staff over the long term. Among other things, it encourages internal promotion, which involves on average more than 10 percent of the workforce every year. To provide the best conditions for the success of every employee, it also has internal assessment systems that complement annual interviews, as well as personalized support to target and develop key skills more effectively.

In 2021, the CSTB signed a corporate agreement on teleworking allowing up to three days of telework a week to ensure the well-being and safety of its employees and maintain their commitment in a context still marked by the health crisis. At the same time, it promotes a genuine balance between personal and professional life. The work conducted under the French government’s recovery plan will also improve and modernize the working conditions and environment of employees, as well as the use of exoskeletons and the continuation of ergonomic studies. —



## CREATING AND SHARING KNOWLEDGE

# CIM/URBAN DIGITAL TWIN

## Using data for urban development projects



► EPA Euroméditerranée, Les Fabriques project/Visualization of the program plan by type

**The CSTB is expanding its CIM expertise through experimentation and research projects with developers. It concluded a framework agreement with “Rennes Métropole” - the Greater Rennes inter-municipal authority - on the urban digital twin.**

During urban development projects, many stakeholders - contractors, urban planners, consulting firms, developers, architects, companies, community services, etc. - create and exchange a wide array of information. *“Better use of this data would make it possible to improve project management and assess outcomes in terms of the objectives set,”* Nicolas Naville, Head of Digital Technology for the Environmental Performance of Cities and Buildings, points out. *“It also facilitates coordination between project stakeholders as well as understanding and buy-in. Finally, it fosters sharing of the information generated with local authorities.”*

### CIM: research partnerships on the ground

Like BIM (Building Information Modeling) at the scale of the building, CIM (City Information Modeling) organizes all the data from multiple sources and in various formats at the different scales of projects and in their distinct phases.

In recent years, the CSTB has signed agreements with several developers to guide them in this process of data use. Experimentation has taken place on a number of projects with specific objectives. For example, for the Descartes project of the EPAMarne/EPAFrance public development agency and the *Les Fabriques* project of EPA Euroméditerranée, the aim was to use the data from the models to **visualize indicators that are useful for monitoring the project**. To ease the coordination and management of the interfaces of EPA Bordeaux Euratlantique’s *Belvédère* project, **the import of BIM models into Navisworks and superimposing them on the Civil 3D public spaces model made it possible to detect interface problems between buildings and public spaces**, such as sill heights and the connection of public and private networks.

EPA Euroméditerranée provided 3D visualization of the project in its environment **to help the public understand and take ownership of the *Les Fabriques* project.**





In 2022, the CSTB is continuing its R&D collaborations with public developers and is taking collective action with some of them (EPAMarne/EPAFrance, *Grand Paris Aménagement*, Paris La Défense, EPA Paris-Saclay, EPA *Euroméditerranée*, EPA Bordeaux Euratlantique, *Espaces Ferroviaires*) **to pool advancements and identify new lines of research.**

**Discussions will focus on innovations for the property development profession, combining the digital and environmental transitions** (linking the CIM approach with studies to optimize projects, environmental assessment, monitoring of operational performance, etc.). The challenges of capitalizing on information and sharing it with local authorities will also be considered in discussions of **the creation of a harmonized data reference system for modeling public spaces.**

### Urban digital twin: a planning and operational tool for local authorities

CIM is aimed at developers during the planning, design and construction phases of urban development projects. Before and after projects, there are strategic planning and operational phases that fall under the responsibility of local authorities. **The concept of a digital urban twin then comes into play, aiming to comprehensively understand the challenges of managing urban data throughout the life cycle.** “Rennes Métropole”, one of the most advanced metropolitan areas on the subject, signed an R&D framework agreement with the CSTB on structuring data generated by the urban digital twin to develop this approach on its territory and integrate it into its information system. It is planned to experiment with uses based on cross-referencing multiple dynamically changing data (data on the built environment, sensors, resident feedback, operations). *“Once operational, the urban digital twin will help local authorities meet the many challenges they face, which often combine increasing complexity with greater need for collaboration between stakeholders,”* says Naville. —



► Noise modeling, Rennes and Rennes Métropole, 3D software



### TWO INNOVATIVE STANDARDS FOR THE WELL-BEING AND INDEPENDENCE OF SENIORS

The CSTB and its subsidiary CERTIVEA, that specializes in the certification of sustainable living environments, are involved in the implementation of two innovative standards aimed at promoting the independence of seniors and their active engagement in society, while respecting their individual life choices. Based on the principles of the World Health Organization and quality of life indicators, they favor **a holistic approach to the relationship people have with their environments.**

Dedicated to the design of age-friendly housing, the European Homes4Life standard was designed as part of a research project linked to the EU's Horizon 2020 research and innovation program. Its operational development is under way.

**A second standard is dedicated to the quality of life of people living in homes for dependent seniors and those living in residences for independent living. It aligns with the transition to the premises of tomorrow** and responds to the aspirations of residents, their families and professionals. It is under development with the Departmental Council of Hauts-de-Seine, and is based both on the OsmoZ label (operational label for quality of life at work developed by CERTIVEA) and Homes4Life project.

#### Find out more



Homes4life Certification  
for ageing in place



OsmoZ label



## GUIDING INNOVATION

# UNDERSTANDING USES

## uses to better control the energy costs of housing units

**The Ecco Dom program aims to reduce energy consumption in French social housing overseas. Renoptim sets out to optimize summer comfort while reducing the use of air conditioning in apartments in metropolitan France.**

Supported by the CSTB and the Union for Social Housing Overseas (USHOM), the **Ecco Dom program wants to reduce energy consumption by social housing tenants in French overseas departments and regions**. The first phase focused on studying the behavior and practices of residents. The CSTB installed equipment in 200 housing units in the five French overseas departments and regions and experimented with eco-friendly practices with tenants. In 2021, it also conducted a sociological study of some of the participating families in Reunion Island. The second phase of the program, led by USHOM, will consist in raising awareness of energy savings and assisting residents in adopting eco-friendly practices.

### Sociological study

The sociological study was divided into three phases. First, a qualitative analysis was carried out with 21 families through semi-structured interviews and visits to their homes, which the Ecco Dom program equipped before the environmental behavior testing phase. **Workshops were then organized with local residents and associations as well as housing operators on the lessons learned from the sociological analysis.** Finally, visits, observations and interviews will take place with five households in 2022 in the environmental behavior testing phase.

The qualitative analysis included the characteristics of the housing units and those of their environments, climatic differences between the coast and rest of Reunion Island, the urban or rural situation, the date of construction of the residence, its orientation, and the floor and size of the housing unit, which could hinder the adoption of eco-friendly practices by families. In urban environments, which are denser and noisier, residents limit natural ventilation at night and use energy-consuming appliances to keep cool.







The study also included lifestyle and the composition and income of families. Low-income households adopt economical practices that are not seen as eco-friendly but as deprivation, such as quick, lukewarm showers. On the other hand, some of their consumption habits act as barriers to the adoption of eco-friendly practices, like the purchase of second-hand appliances, that consume more energy than new appliances.

The workshops showed that residents wanted to understand their energy costs better in order to guide their practices in the direction of savings and doing the right thing. They were particularly sensitive to the practical experiments conducted as games and appliance handling illustrating the link between the practices adopted and energy consumption.

### Renoptim: controlling the energy consumption of air conditioning in apartment buildings

**Climate change over the next 50 years will result in frequent heatwaves that will have an impact on indoor comfort.** By 2050, ADEME (the French Environment and Energy Management Agency) predicts that half of all housing units will use air conditioning. The issue concerns apartment buildings, that exist more in urban areas and are more exposed to urban heat islands and noise pollution, obstacles to natural ventilation. **With the Renoptim project, it is necessary to adapt the summer comfort solutions to the exact needs of each housing unit to control electricity consumption related to the use of air conditioning.**

**The work of the Ecco Dom project - focused on French overseas departments and regions - contributes to Renoptim, both in terms of the methodology developed and certain outcomes that can be implemented in metropolitan France. The synergistic benefits of the two projects will serve the users of apartment buildings.** Feedback from the Union for Social Housing (USH), a partner of this program, will also provide a source of information for considering new ways of improving summer comfort beyond the experiments already conducted.

*"The CSTB has developed a digital method for assessing thermal comfort. It will be integrated into three appliances for residential building stock managers and will make it possible to target priority housing units,"* explains Charles Pelé, Project Manager. Another digital tool will help identify technical solutions for maintaining indoor comfort. An on-site test campaign involving about 100 housing units will add to knowledge of user behavior, including the impact of eco-friendly practices on the correlation between physical measurements and perceived comfort. Finally, these field results will enable us to refine digital simulation models. A guide to eco-friendly practices will be written for tenants. **Intended for housing complex and building managers, these deliverables will serve both as drivers of daily action as well as decision-support tools for work on a larger scale.**

**Find out more**



ECCO DOM project

## COVID-19: ASSESSING CONTAMINATION HAZARDS IN INDOOR ENVIRONMENTS

**Since the end of 2020, the CSTB has been conducting research on providing tools to assess and manage SARS-CoV-2 contamination hazards in indoor environments.**

The Department of Hauts-de-Seine commissioned the CSTB to model SARS-CoV-2 exposure and analyze the effectiveness of ventilation strategies in Hauts-de-Seine and Yvelines secondary schools. The project led to the development of a best practices guide to reducing the spread of the virus.

As an extension of this work, **the CSTB initiated a research project to better predict the exposure of building occupants to respiratory viruses.** CSTB experts analyzed available data on the release and dynamics of respiratory viruses, with special focus on studies related to SARS-CoV-2. A virus spread model has been included in the MATHIS-IAQ software making it possible to estimate the likelihood of contamination in indoor environments by considering the influence of several factors (ventilation strategies, window opening, distancing, mask wearing, season, and type of premises: school, office, restaurant, retail space, etc.).

This work is continuing in 2022 as part of the GRIPA collaborative research project, winner of a call for research proposals launched by ADEME to develop innovative solutions. Among other things, this new project is helping to **create an engineering approach that uses digital modeling to assess the risk of airborne contamination by infectious agents in indoor environments to develop appropriate and effective reduction strategies for use in building management.**

**Find out more**



Indoor air quality expertise





## INCREASING SAFETY AND HIGHLIGHTING PERFORMANCE

# FOR ENERGY RENOVATIONS

that include comfort and health



**The QSE research project offers a straightforward method to assess the overall energy, health and comfort performance of buildings.**

The “Health and Energy Quality of Renovations” (QSE) project led by the CSTB stems from the PROFEEL program. Supported by professional building organizations to stimulate technical innovation in energy renovation, **it enables effective massification of renovation. Launched in 2019, this research project is developing a simple and inexpensive method of assessing the overall energy, health and comfort performance of renovations.** Intended mainly for project owners, managers of housing complexes, social housing operators and, potentially, individuals, this method assesses **energy consumption, sanitary quality of indoor air, and ambient conditions** (thermal, acoustic, visual and olfactory) in buildings.

## When energy renovation degrades sanitary quality

By focusing on reducing energy consumption, some building renovations may have led to a degradation of sanitary conditions. This is what several studies of the Indoor Air Quality Observatory (OQAI) have revealed. Driss Samri, Director of Health & Comfort at the CSTB, says that *“improving the waterproofing of building envelopes to reduce energy losses can result in lack of air renewal and therefore deterioration in indoor air quality if no ventilation system is provided.”* This can lead to moisture build-up, which fosters growth of mold. Externally insulated walls, which are thicker, can reduce natural light. Finally, by attenuating external noise, insulation sometimes causes the emergence of noise from inside buildings (neighbors, elevators, etc.), which can be even more disturbing. *“Thus, we must seek overall comfort that includes the sanitary quality of indoor environments in addition to energy savings,”* stresses Samri.





## Simple and affordable tools

*"The QSE method had to be a tool accessible to all, with simple protocols and low-cost means of measurement that don't require special skills,"* adds Nelson Rodrigues, PROFEEL program leader for the CSTB. To assess air quality, there are now affordable and easy-to-use smart sensors. A simple app downloaded to a smartphone can take acoustic measurements, and smart meters can provide data to determine energy consumption easily.

Tested before and after work in about 20 buildings for housing, schools and offices, the method was published in a guide at the end of 2021. In addition to describing measurement methods, the guide promotes **a standardized, easy-to-understand interpretation of the outcomes through an overall performance indicator.**

**When used before building renovation, it identifies areas for improvement to include in the planning of the work. After renovation, it documents sanitary quality and comfort in the renovated building.**

## QUARTET as an extension of QSE

The QSE method is a first step in raising awareness and involves as many stakeholders as possible. **The QUARTET project was launched in 2022 as part of the PROFEEL 2 program, and is a continuation of the QSE project. It offers guidance to the construction sector in the use of this method.** It provides for the setup of a resource center linked to the tools now available to professionals. At the same time, the development of knowledge is continuing after the end of instrumentation installed in schools and office buildings through the QSE project. —

### Find out more



Health and comfort  
expertise at the CSTB



QSE QUARTET:  
a project from the PROFEEL program



► Standardized air quality measurement device



## NF SHUTTERS: EXTENSION TO OUTDOOR CANVAS BLINDS

The NF Shutters label currently certifies shutter products fitted in front of standard windows, French windows, roof windows and glass roofing. Among them, you find mainly shutters (roller, folding) and outdoor Venetian blinds. **The Certification Committee favors extending the scope of the label to other outdoor sun protection products and, more specifically, outdoor canvas blinds.**

This change aims to meet the specific needs of users based on building typology. It should appear in 2022 with a change in the label's name for more clarity for the public, entirely in line with the new summer comfort requirements in the French environmental regulation (RE2020). Like other outdoor sun protection products, canvas blinds play an essential role because they fit between the sun and glass walls. This way, they **regulate both heat and light inputs in buildings to adjust habitability characteristics based on climatic conditions and the needs of occupants, thus reducing the use of air conditioning.**

### Find out more



Understanding  
certification



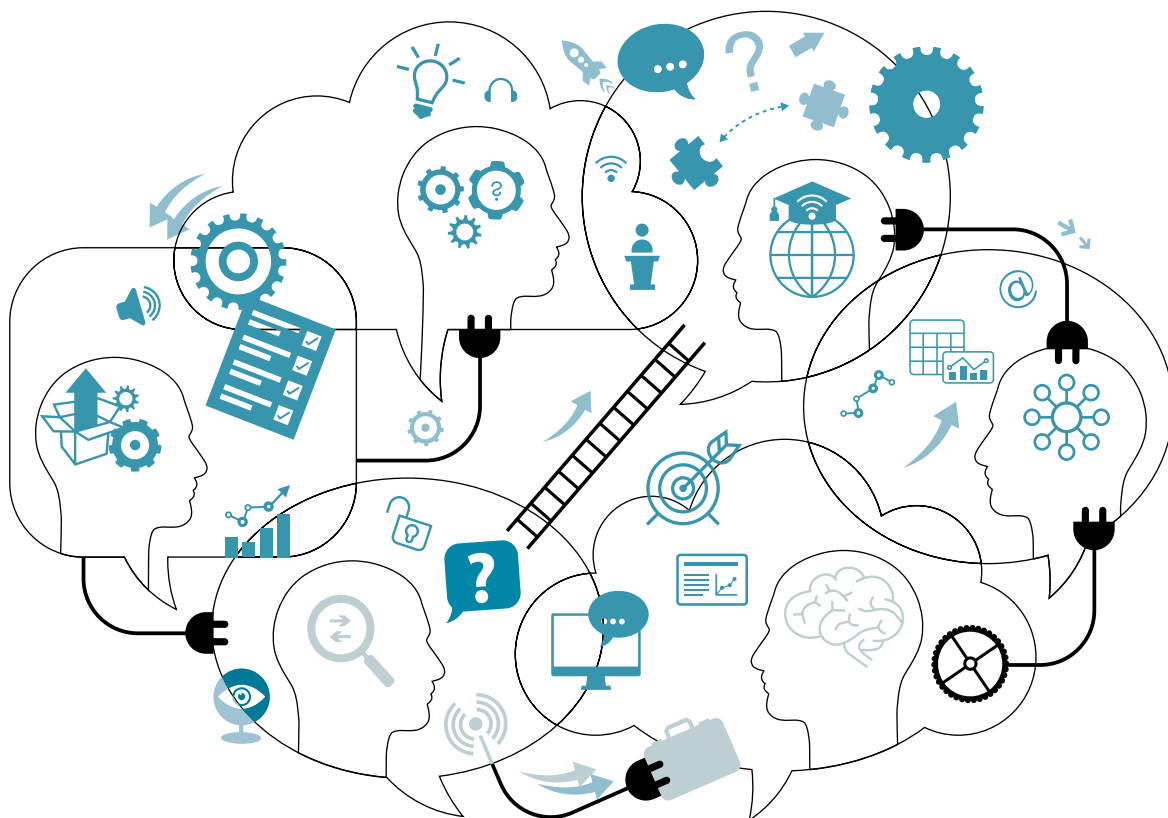
NF Closures  
certification



# FOR AN EMBEDDED KNOWLEDGE

management system

In April 2021, the CSTB launched a Knowledge Management (KM) initiative. *“The aim is to set up an embedded system to optimally manage and exploit the intangible assets of the CSTB in connection with external knowledge bases,”* explains Hervé Charrue, Deputy CEO in Charge of Research and Development. **These assets take varied forms: knowledge, know-how and soft skills, as well as the capacity for individual and collective expertise.** *“KM is not just a new information architecture. It also encompasses exposure to knowledge and its organization and transfer among employees.”*







## A program in three phases

**The KM project is taking place in three phases: auditing, scoping and rollout.**

The audit was mainly carried out in 2021 and continued in the first quarter of 2022. It consisted in taking stock of the practices and experience of employees in terms of knowledge and skills' management, identifying KM initiatives and processes already in place at the CSTB and identifying KM stakeholders. This internal KM maturity analysis was supplemented by monitoring the practices of other research centers and private companies.

In 2022, scoping will consist in establishing an 18-month roadmap. It will involve precisely determining the challenges facing the trades, the objectives to be achieved, the benefits they will bring and the collective and individual efforts they will require **to build a common vision that determines the choice of governance, an action plan and communication operations to support the transformation.**

Finally, in the program's rollout and adjustment phase, some existing initiatives will be improved and a few rapid and demonstrative pilot projects will be launched along with longer-term development projects.

## Unifying best practice

In 2021, Séverine Kirchner, Director of Knowledge Management and Scientific and Technical Partnerships, met with CSTB employees to learn about their behaviors, motivations, gaps and opportunities for everything related to knowledge sharing. She noted great maturity in the analysis and enthusiasm for the approach in the teams. Even before the KM project, they set up learning pathways for the trades, practice-sharing communities, collaborative tools and internal and external communications. Storage, backup and security of data from research or testing activities are ensured through various databases.

**All these practices have yet to be brought together to make it easier for employees to upskill and for the CSTB to become a learning organization through knowledge sharing and reuse.** —

## CSTB DAY: "RESPONSIBLE TOGETHER"

**After a year off because of Covid-19, CSTB Day returned to focus on CSR.**



The principle is that participants are grouped in teams and have cards representing the different components of climate change that they must associate based on their cause-and-effect relationship. **About 100 employees created 15 murals with the help of trained CSTB volunteers. The volunteers run workshops throughout the year to raise awareness of the climate emergency, a major 2023 objective for CSTB employees.**

Also on the program: cooking classes for a sustainable and healthier diet, wellness workshops, a 6000-step challenge and a Solidarity Race to collect donations for an association. **In 2022, "harmonious living" will be highlighted on this company day.**

As part of the program on "Developing and promoting social and environmental responsibility" in the 2020–2025 business plan, this day brings together employees from the four CSTB sites and took place on June 25, 2021, in mostly digital format given the health crisis.

**Various activities were organized for this time of conviviality and social cohesion. The "Climate Mural," a major employee awareness program on climate issues, was launched.**



# ASSERTING

## OURSELVES AS AN INDEPENDENT AND ETHICAL GROUP

- 38 — Creating and sharing knowledge
- 40 — Guiding innovation
- 42 — Increasing safety and highlighting performance
- 44 — In-house CSTB activities





## THE PERSPECTIVE OF CÉLINE HECQUET

Director of Quality and Ethics

**“Retaining our customers, partners and talent, and capturing new ones, requires commitment to a CSR approach. In the collective subconscious, it cannot be otherwise. The CSTB carries out its missions in accordance with ethical rules and independence, which guide what we do every day.”**

**A**s a state-owned industrial and commercial company, it is in the CSTB's DNA to carry out its missions in an ethical and independent manner, both internally and with all its key audiences.

To do this, the CSTB must comply with strict accreditation rules concerning transparency, impartiality of judgment and confidentiality, which contribute to strengthening its role as a model of ethical leadership.

The ethics system adopted by the CSTB calls on every employee to complete and sign an annual declaration of interests form. Based on these declarations, the CSTB organizes the prevention of conflicts of interest to ensure that its missions are conducted fairly and address society's concerns by improving living spaces and environments.

The CSTB continues to think ahead to uncover and anticipate problems using its expertise in crisis management for buildings and developing intervention methodologies from its research.

It produces and disseminates knowledge through professional training and documentation for construction and development stakeholders for whom speed of execution, time savings and process improvement are key issues. The CSTB supports them by offering appropriate tools that truly meet their needs. In 2021, the development of two guides to help assess innovative processes - as part of the construction of the Olympic Village for Paris 2024 - as well as the launch of operational technician training in window installation for job seekers and environmental assessment are just a few examples.

Internally, 2021 was marked by the CSTB's desire to transform and improve itself and rejuvenate its operations. This included projects for the implementation of knowledge management and a CSR charter for its suppliers.

The internal and external ethics committees, guarantors of the system set up in 2014, guide the CSTB in implementing these new internal practices and meeting its obligations to society, its customers and professionals.

Based on its experience, the CSTB has decided to modernize and strengthen its ethics charter, that is based on the CSTB's values of responsiveness and customer service, scientific and technical excellence and rigor, impartiality and transparency, openness and social and environmental responsibility. This development affirms the commitment of the CSTB and all its employees to strict ethical principles: impartiality, transparency, sharing, secrecy, confidentiality and professional discretion. —



## CREATING AND SHARING KNOWLEDGE

# A TOOL FOR RESPONDING TO DISASTERS



**The CSTB has used its expertise in all aspects of construction to develop a specific method for crisis management affecting buildings.**

Authorities requested the CSTB's technical expertise during several disasters affecting buildings, and **this experience led to the development of a methodology to guide crisis management.** *"This methodology applies to most crises affecting buildings and their users and draws on all of the CSTB's skills, particularly regarding structures, natural, health and fire hazards, pathologies related to energy and environment, and improper performance or significant deterioration of structural parts,"* explains Romain Mège, Director of Strategic Research Action.

## Cyclones, fires and building collapse: same approach

In September 2017, Hurricane Irma struck the island of Saint Martin in the French West Indies. Ménad Chénaf, Deputy Director of the Safety, Structures and Fire Performance Department, went to the site to assess the objective level of damage. A team of experts then worked with all local stakeholders to draft simplified repair records for the affected buildings and recommendations to increase the resilience of the repaired buildings at the request of the French Department for Housing, Urban Planning and Landscape (DHUP) and the Directorate-General of Overseas Affairs (DGOM).

Beyond this operational response, the CSTB was mandated by public authorities to conduct an international study of the wind speeds used in sizing to withstand hurricanes in the United States, Japan and Australia compared to those used in France.

Data from Irma and this research helped to advance work on the sizing of structures to address cyclone hazards, combined or not with seismic hazards.

In November 2018, three dilapidated buildings in the old center of Marseilles (Rue d'Aubagne) collapsed, resulting in the death of eight people and cordoning off of 33 buildings nearby.

**National, metropolitan area and city authorities requested help from the CSTB, first, to understand the phenomena that may have caused the collapses** and, second, to determine the conditions and preconditions for the return of residents to the housing units that were located within the safety perimeter and had been evacuated immediately after the disaster. The project to renovate the city center of Marseilles was entrusted to a French local public development corporation in the national interest (SPLA-IN). **It requested the support of the CSTB to assist it in the rehabilitation projects of the four priority city blocks.**



## A four-phase methodology

The intervention methodology was developed by the CSTB in response to a disaster affecting buildings, and is based on time frames:

- **Phase 1: damage assessment** a few days after the disaster. Building diagnostics measure the defects and hazardous areas that must be evacuated. A list of additional diagnostics is established defining the methods of intervention specific to the levels of dangerousness identified;
- **Phase 2: objectivation and preparation for the exit from the crisis** a few weeks after the event. The CSTB analyzes additional diagnostics to understand the causes and factors influencing the vulnerability of the built environment and provides technical insight to help authorities to decide when buildings can be occupied again;
- **Phase 3: support at the end of the crisis** a few months later. The CSTB measures the vulnerability of buildings outside the affected area to quantify the local hazard beyond the epicenter of the disaster. It analyzes repair solutions to increase the resilience of the built environment, provides robust tools and trains local crisis management teams;
- **Phase 4: implementation of sustainable resilience** one year after the disaster. The CSTB guides local and national authorities in implementing measures that reduce the vulnerability of existing buildings to this type of disaster in a sustainable manner. This can include proposals for regulatory changes and specific projects to implement the recommended measures or establish pilot projects to rehabilitate old buildings in a resilient and sustainable manner.

## French national buildings database

*"In parallel with this methodology, that is now operational, we developed a tool that cross-references all open databases nationally to enable you to view each address. This is particularly useful for improving operational responsiveness when assisting crisis management," adds Romain Mège.*

This National Buildings Database (BDNB) results from the work performed in the Go-Rénove project as part of the PROFEEL program. The CSTB is now working to expand knowledge of the vulnerability of old buildings using prototypes developed during various crisis management missions (survey of mid-rise buildings, risk mapping of old buildings in Marseilles, etc.). **This involves identifying and cross-referencing existing local databases to give access to as much information as possible to people involved locally in crisis management to learn about probable causes of the crisis encountered, better chart the perimeter and speed up measures to improve the safety of buildings.** —

### Find out more



Go-Rénove:  
a project from the PROFEEL program

## REHABILITATION PLAN FOR SCHOOLS IN MARSEILLES: A MULTI-CRITERIA METHODOLOGY DEVELOPED BY THE CSTB

**A research mission for the development of a methodology for efficient, comprehensive rehabilitation of Marseilles schools was proposed by the CSTB and validated by the city of Marseilles and the French state.**

Commissioned by the state and the city of Marseilles and led by the Public Corporation for the Renovation of Marseilles Schools (SPDEM), it arises from the initial R&D mandate to learn about the problems of the deteriorated Marseilles school building stock and its mapping, carried out throughout the city in the context of supporting local authorities after the collapse of three buildings on Rue d'Aubagne in November 2018.

Its purpose is to study four school typologies representing the majority of schools in the Marseilles building stock, and even the national building stock: schoolhouses (1878–1915), Jules Ferry-type schools (until 1936), EGGER-type schools (1950–1960) and GEEP-type schools (1960–1970).

**Based on a multi-criteria diagnosis using a sample of schools representing these typologies, the objective is to offer comprehensive rehabilitation strategies making it possible to act on all the criteria relevant to the type of establishment, taking into account:**

- Risk mitigation,
- Optimal quality of uses,
- Resource savings,
- Quality of living spaces,
- Adapted digital use.

In 2021, the launch of this 18-month comprehensive research task stemmed from a preliminary study analyzing the potential rehabilitation of GEEP-type schools performed to better describe their current state and their deviations from current regulations and to determine the challenges of multicriteria rehabilitation compared with a demolition-reconstruction strategy.



► Ruffi de Marseille Elementary School





## GUIDING INNOVATION

# WORKS FOR THE OLYMPIC GAMES:

## two practical guides for innovation

The CSTB and the Olympic Delivery Authority (SOLIDEO) have developed two guides to ease the assessment of innovative systems as part of the design of the Olympic Village, which will host athletes in summer 2024.

The Olympic Village project, which must use a timber-framed structure, requires all the construction stakeholders to devise innovative solutions to the challenges of this type of structure. **Given these challenges and the innovations they generate, SOLIDEO asked the CSTB to prepare two guides to assist in the design of non-standard outdoor thermal insulation techniques for wood structures.**

To conduct these works, the CSTB engaged stakeholders from the timber industry (ADIVbois, which is an association for the development of timber-framed residential buildings, the timber sector project France Bois 2024, and the Club des Industriels, set up by industrial companies) and the testing, inspection and certification provider Socotec.

### Innovation for the development of wood structures

**These two guides enable project ownership teams to adopt non-standard techniques and thus facilitate the obtaining of Technical Experimentation Assessments (ATEX) and Technical Appraisals (ATec) conducted by the construction and development stakeholders who are building the Olympic Village.**

The first guide addresses the design of an external thermal insulation composite system (ETICS) on a timber-framed facade or structure and the second describes the processes for terracotta cladding on a timber-framed facade or structure.

In charge of developing the sites for the Games taking place in Paris in 2024, and as part of a sustainable urban project linked with projects of the local authorities concerned, SOLIDEO has relied on the skills and expertise of the CSTB in timber-framed structures to facilitate access to this material in the project agreement for the Games.

This initiative is part of a collective approach in the public interest led by the CSTB, SOLIDEO and project partners. It will **strengthen research in timber-framed structure operations and promote the use of biosourced materials that store carbon.** Thus, residential buildings with fewer than eight floors can have timber-framed structures, while high-rise buildings (taller than 28 m) will be made of materials combined with wood on the facade.



► Olympic Village

### Mainstreaming support for innovation

Thanks to these guides, three developers (Eiffage-Nexity, VINCI and Icade), including five general contractors, have undergone about 15 ATEX assessments, usually for several buildings (up to 12 for a single ATEX), as well as several non-standard techniques (up to 4 for a single ATEX). The first innovative exterior insulation systems for facades or timber-framed structures were implemented in early 2022.

**The release of a third guide, dedicated to assisting in the design of fully accessible, walk-in shower trays on wood plank floors for the Olympic Village, is planned for summer 2022.**

Developed for the construction of the Olympic Village, these guides are now available to other construction sites that have the same design base in metropolitan France. —

#### Find out more



ETICS design guide for timber-framed facades and structures



Terracotta cladding design guide for timber-framed facades and structures



## GRAND PALAIS ÉPHÉMÈRE: TWO ATEX ISSUED BY THE CSTB

**The CSTB conducted and issued two ATEX for the roofs and stretched fabric facades of the Grand Palais Éphémère exhibition hall.**

A temporary building with 10,000 sqm of space constructed on the Champ-de-Mars in Paris, the *Grand Palais Éphémère* will host events usually organized at the *Grand Palais* while the latter is under restoration. Consisting of a large and a small nave (52m x 140m long and 34 m x 130 m) that intersect and form loops, the structure is covered with a roofing system and facades designed of stretched fabric reinforced by metal cables on a timber-framed structure. The system was developed by ISAO, a specialist in fabric architecture. It consists of PVC-coated prestressed fabric membranes and ETFE membranes with peripheral aluminum profiles.

The facades concerned are those of the large nave, as well as the coverings of the lattice girders of the four gables.

**After investigation, favorable ATEX technical assessment was issued.**



► Installation of membranes

**Find out more**



Technical Experimentation Assessment (ATEX)





## INCREASING SAFETY AND HIGHLIGHTING PERFORMANCE

# ECO-DESIGN

of products at a glance



**The CSTB is developing a method for assessing and labeling products based on four criteria to promote eco-friendly construction.**

Eco-design and the circular economy are now being pushed by public authorities through French laws such as ELAN (for the reform of housing, planning and digital technology), AGECE (against waste for a circular economy) and "Climate and Resilience." European regulatory indicators reflect the reality of supply chains at a given time but do not provide an indication of the potential for recycling and reuse of products and equipment in a rapidly changing environment. The establishment of complementary indicators was therefore necessary to **inform construction stakeholders and meet the challenges of resource saving**. Indicators include recycled and renewable input material, extension of the duration of use with analysis of ease of disassembly of components, reuse potential and reparability.

## Rating based on four criteria

*"To best respond to the expectations of construction stakeholders, we met with representatives of public authorities, project owners, project managers, building control bodies, companies and pilot industrialists willing to engage in such an approach,"* explains Florent Lyon, Deputy Director of Development at the CSTB.

### The outcome was a product classification using four criteria:

- ▶ **proportion of recycled or renewable material,**
- ▶ **ease of disassembly,**
- ▶ **reusability** (product life cycle extension),
- ▶ **recyclability** (optimization of end of product life cycle).

Each of these criteria is assigned a rating - A, B, C, D or E - from most favorable to most unfavorable. Work is also underway to cover all building products, equipment and materials, including the concept of reparability.

To be eligible, products must meet two prerequisites: submission of the minimum technical guarantees described in the benchmark and filing of an environmental and health declaration datasheet (FDES) verified by an independent third party, as required by regulations since 2017.





## WINDOW INSTALLATION: PROFESSIONAL TRAINING FOR JOB SEEKERS

### The CSTB has set up operational technician training in window installation for job seekers.

Spearheaded by the R.A.S Intérim employment agency, which is recruiting employees for local companies specialized in window installation, and supported by the CSTB Grenoble in partnership with the Compagnons du Tour de France training center in Échirolles, this certified training took place from March 22 to May 31, 2021, at the CSTB in Saint-Martin-d'Hères.

#### ► Objectives: help the recruitment of trained personnel in a sector under strain and enable sustainable return to work.

Twelve job seekers took part in the training, funded by Pôle Emploi (the French government employment center) and the Auvergne-Rhône-Alpes region, to obtain the CCP1 (certificate of professional competence) in "Installing and fitting door and window frames and exterior shutters" for the professional title "Door and window frame installer/fitter" and various certified skills (electrical, OHS, scaffolding, movement and posture).

► **Topics: theory, practical training** (reading blueprints, fixing systems, window installation, roller shutters and garage doors), **commercial awareness, and know-how**, as well as a three-week internship in a company before they are hired.

Following this initial experience, the CSTB "Training by doing" team repeated this initiative in the first half of 2022 in partnership with Compagnons du Tour de France in Échirolles and with the assistance of the employment center Maison de l'Emploi des Pays Voironnais.



## QB48

### "WINDOW INSTALLATION SERVICE"

This certification attests to the added value of a window installation company. It makes it possible to choose a reliable company whose staff receives regular training and whose skills and organization are audited by the CSTB. It ensures quality of service monitoring, greater trust between stakeholders and better customer satisfaction.

#### Find out more



Window installation service –  
Certifications – CSTB Assessment

The assessment is issued for a given area of application, and the label on the product provides access via a QR code to a database explaining the classification. This database is also accessible using a search engine to compare products of the same family. It offers the opportunity to capitalize on the information and makes it immediately retrievable for subsequent product filings.

If the producer responsibility organizations that manufacturers use recognize the CSTB's environmental assessment approach, they could vary the contribution of industrial companies based on their engagement in the circular economy.

## Anticipation of future regulations

Regarding the new mark's business model, the CSTB opted for a free service, at least initially. *"Such a classification is of interest to specifiers only if there is a large database of labeled products,"* emphasizes Florent Lyon, who is focused on persuading various industrial sectors. There should be interest because **it anticipates the future French extended producer responsibility (EPR) regulation**, which now applies to manufacturers of electrical and electronic equipment and furniture producers. These industrial companies are responsible for the collection, cleanup and recovery of their products at the end of their lives. In France, to meet their obligations, industrial companies entrust this task to producer responsibility organizations accredited by public authorities. The ecotax paid by consumers, the amount of which is added to the sale price and appears on the receipt, is used to fund this service. Industrial companies in the construction industry are on the list of the next sectors that must comply with this obligation starting on January 1, 2023.

## 2022 launch

A general benchmark was developed in collaboration with representatives of industrial companies, contractors, public authorities, waste reclaimers and circular economy specialists. It will then be broken down by product family. Manufacturers of floor coverings and facade cladding are already showing interest. Discussions are taking place to develop partnerships to broaden the scope of this work and extend it to all building products, equipment and materials.

An initial family of products could be offered this eco-design quality mark before summer 2022. *"These developments are a very good opportunity to promote the French position ahead of the development of the circular economy in the construction industry and to spread the word throughout Europe,"* concludes Lyon. —



## IN-HOUSE CSTB ACTIVITIES

# STRENGTHENING THE SCIENTIFIC partnerships at our major facilities

**A Platform Scientific Council for the Jules Verne wind tunnel was set up to strengthen and develop scientific partnerships with academic laboratories. The same will be true very soon for the other major CSTB test facilities.**

The CSTB has always maintained partnerships with the academic world of universities and major national and international research organizations, including thesis programs. To ensure they continue and result in the joint creation of projects on shared topics of interest, in 2015, the CSTB strengthened long-standing scientific partnerships through four-year contracts with different institutions on specific topics. Then, at the end of 2019, it concluded a five-year framework agreement with the CNRS (the French National Centre for Research) to expand **this approach, which links basic and applied research to serve the public interest and economic stakeholders.**

## Upskilling

Dany Escudié, Director of Research at CNRS and President of the Scientific Council of the CSTB, proposed making better use of the potential of major facilities like the Jules Verne wind tunnel, Vulcain fire test facility and AQUASIM research and test platform dedicated to the water cycle, by opening them to academic laboratories. **The aim is to foster exchanges in experimental approaches and digital simulations to create synergy between laboratories and advance the skills of each partner in the areas of activity of the CSTB.**

Each major facility must have its own Platform Scientific Council (PSC). It consists of experts in the various scientific disciplines involved in the use of the facilities, with the aim of supporting the project. *“These major facilities, which are substantial investments, must be made more visible both nationally and internationally,”* comments Nelson Rodrigues, Deputy Director of Research and Development. *“They have the capacity, but they must make sure they stand on recognized scientific foundations shared with academic partners. The role of the Platform Scientific Council is to convey the contributions of academic research regarding the experimental capabilities of the platforms and their pairing with digital simulation tools. This is so that we can develop them to address more complex questions while using the results already achieved.”*

## Characterizing platforms

The Jules Verne wind tunnel in Nantes is the first platform to initiate this approach. *“It was renovated and enlarged in 2019, and needed a scientific council for it to ensure its scientific and technical legitimacy, given the prospects of strengthening national and international goals for various sectors, such as architecture, transport and airflow management,”* comments Philippe Delpech, Research and Development Engineer in the Climatology, Aerodynamics and Airflow Management Department.



► Assessment of the rain tightness of roof elements in the atmospheric test section of the Jules Verne climatic wind tunnel



As part of its mandates, the PSC guided the CSTB in identifying and prioritizing the actions to take, such as studies, simulations, equipment procurement, to characterize and optimize the various test sections of the Jules Verne wind tunnel. Similarly, taking a more academic approach, the PSC identified unanswered scientific questions to which a platform like this can make a significant contribution as well as experimental and digital approaches that should be put in place.

It was also decided to conduct a specific case study in a configuration that only this platform could achieve, with a view to contributing to an international benchmark that validates innovative digital codes and strengthens the CSTB's ties with its partners, both academic and industrial. The aim is to offer a complete analysis of aerodynamic phenomena around the study objects based on the precision of the results: assessment of transient aerodynamic quantities through wind tunnel measurements and elucidation of the associated phenomena, in particular by visualization of flows and comparison with their representation from digital simulation.

## Digital measurements and simulations

The CSTB determined the characteristics of the study object using the benchmark in reference to a previous international approach: a large bar, with a rectangular section measuring 20 cm in height and 1 m in length, whose 5 m transverse extent optimally uses the width of the Jules Verne wind tunnel test section. A document presenting the proposed study cases for this object and the diagnostics that could be run was submitted to teams outside the CSTB, potentially leading to contributions in both complementary experimental measurement methods and advanced digital simulations. This call for expression of interest was launched at the end of 2021. After a review of the responses in early 2022, the benchmark schedule will be finalized.

**The Vulcan platform is being characterized before the creation of its Platform Scientific Council before the end of 2022.** —

### Find out more



Jules Verne wind tunnel in images



The CSTB's test facilities for innovation



## GENDER EQUALITY IN THE WORKPLACE: THE CSTB IS CONSOLIDATING ITS EFFORTS

**The CSTB's human resources policy emphasizes gender equality and more broadly diversity.**

It has taken specific measures in the areas of inclusion, equal opportunities and nondiscrimination. To reinforce the impact of the actions already taken, the CSTB launched a diversity e-learning module in 2021 to raise awareness among all its employees.

The rate of direct employment of people with disabilities increased from 3.29% to 3.96% (it is expected to reach 4.2%—against the statutory 6%—by the end of 2022), despite the recent revision of the methods for calculating the mandatory declaration of employment of workers with disabilities (DOETH).

**The CSTB has invested significantly to improve the working conditions of the employees concerned both in its production activities and in its service activities.** In addition, in October 2021, the CSTB participated in the first meeting on "Diversity, Inclusion and Quality of Work Life" devoted to disability and held between commercial and industrial public institutions (EPICs). Regular exchanges have since taken place to enable these institutions to move forward together in this area.

Beyond disability, for the first time, the CSTB has supported several employees in professional retraining through skills' assessments to promote the success of their individual projects.

**Finally, the CSTB's commitment to gender equality is reflected in the 2021 index score, which increased by 6 points compared with 2020 to reach 91 out of 100 points.**

### FIND OUT MORE



Ethics approach of the CSTB





# 03

## INSTANT









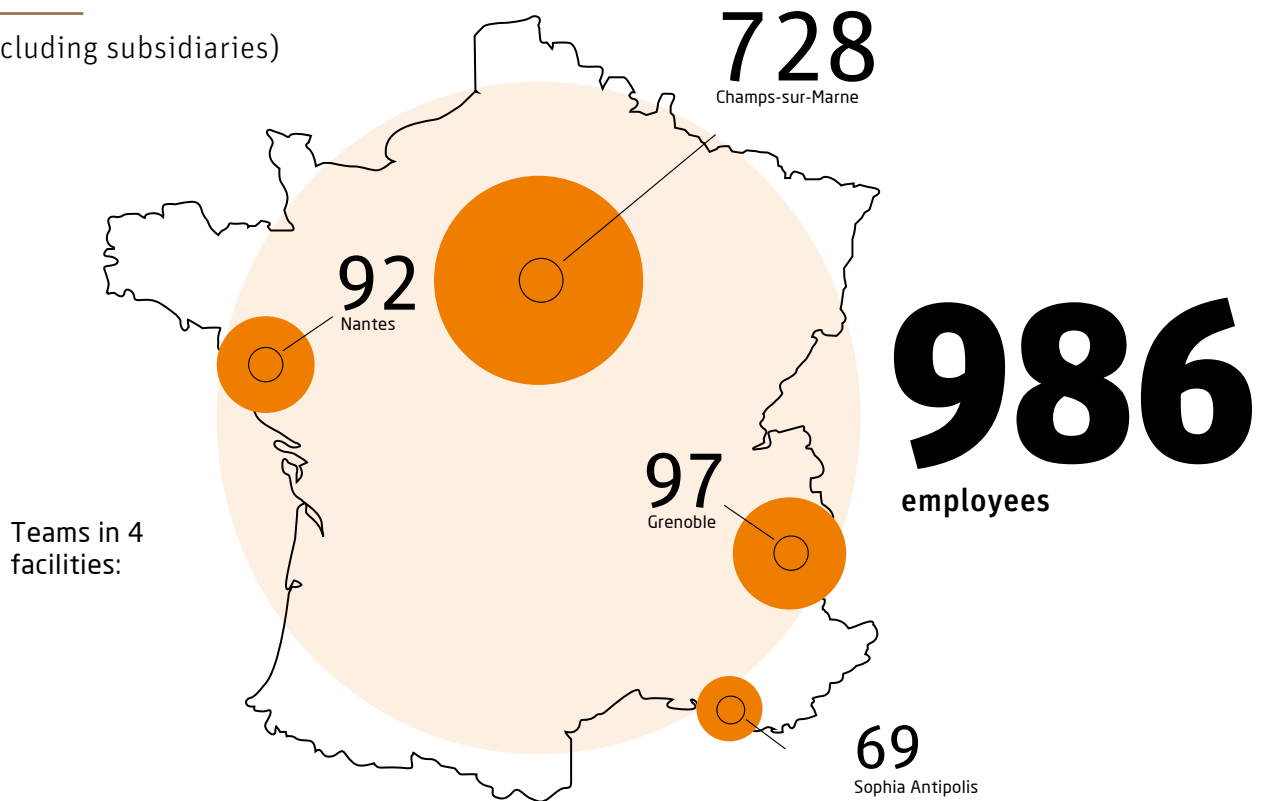


# 2021 KEY FIGURES

AS OF DECEMBER 31<sup>ST</sup>, 2021

## HEADCOUNT & LOCATIONS

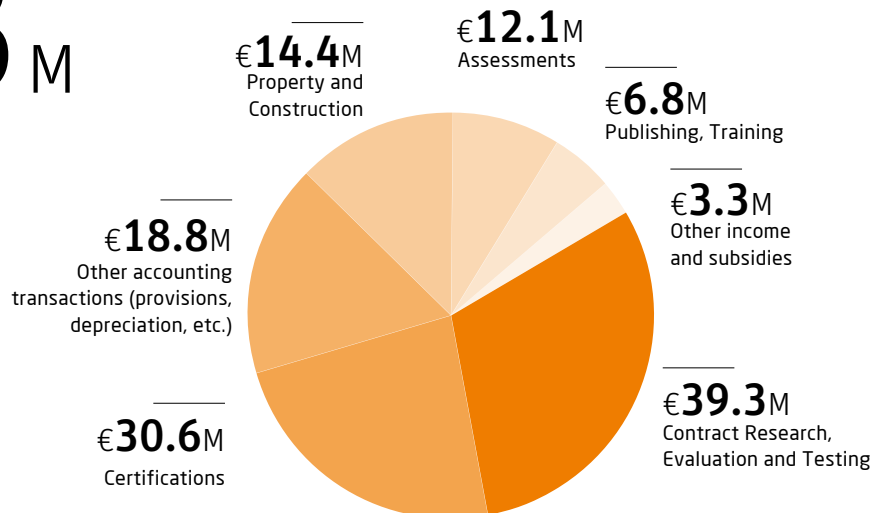
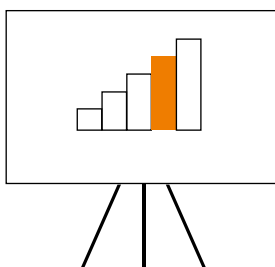
(excluding subsidiaries)



## 2021 OPERATING INCOME

€125.3M

in operating income  
(excluding subsidiaries)



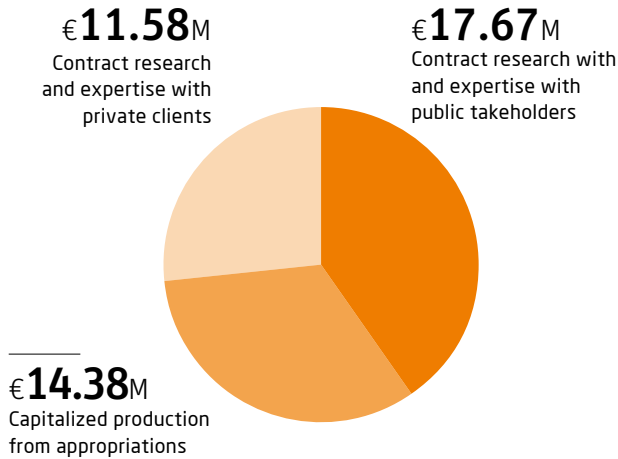


INSTANT

## RESEARCH AND EXPERTISE

### Total Research and Expertise

€43.63M



€4.58M  
External subcontracting  
incorporated into products

€1.2M  
Appropriations  
for investment in  
research equipment

€6.16M  
Contracts with  
partners

€1.47M  
European contracts

55  
PhD students

206  
researchers

33\*  
patents  
\*3 patents and 2 Soleau envelopes  
filed in 2021

77  
publications

## TECHNOLOGY-RELATED ACTIVITIES

131  
ATEX

21  
ETAs (European Technical  
Assessments)

671  
ATec/DTAs published  
All types (excluding  
modification to extend  
validity date), including  
141 "New" types and 495  
revisions initiated  
by committees  
Average 2021 Technical  
Appraisal procedure time:  
8.4 months

### CE marking

522  
certificates



### Product certification

5,060  
certificates

320  
holders  
(15% from abroad)



1,774  
holders  
(57% from abroad)

## DISSEMINATION OF KNOWLEDGE

21,080  
Hours of training completed

152  
Training courses, including  
60 new or updated

18  
Training courses, Premium  
and Become an Advisor

24  
Training courses,  
all or part digital







04/

# SCIENTIFIC AND TECHNICAL

ROAD MAPS: 2030 VISION





## The CSTB focuses its research on topics that reflect society's highest priorities.

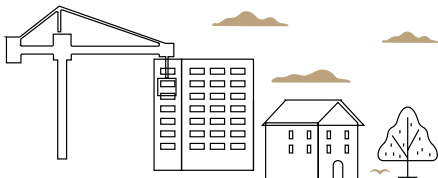
It responds to the expectations of the public who want future buildings that are more energy efficient as well as environmentally and health friendly, compatible with greater biodiversity, more comfortable and pleasant to live in, more connected and, of course, more cost-effective. The substance of these topics and buy-in resulted in four strategic research actions.



### BUILDINGS AND NEIGHBORHOODS THAT PROMOTE HARMONIOUS LIVING

*“The challenge is to create a continuum of “harmonious living,” from the private sphere of housing to the public space, and including our many other living spaces and ways of getting around.”*

SOPHIE MOREAU  
Director Strategic Area of Research



### RENOVATION, INNOVATION AND RELIABILITY IN THE CONSTRUCTION PROCESS

*“If we want to meet the objectives of carbon neutrality and reduction of energy consumption, we need to change our perspective and see innovation as indispensable to the reliability of construction and renovation.”*

ROMAIN MÈGE  
Director Strategic Area of Research

The goal is to have “buildings and neighborhoods that promote harmonious living,” which means working on the main societal challenges in the context of “buildings and cities facing climate change,” focusing on “renovation, innovation and improving reliability of the building process” and mobilizing the “circular economy and building resources.”



### BUILDINGS AND CITIES FACING CLIMATE CHANGE

*“Climate change is a major part of our future. The CSTB must act to mitigate it and adapt the construction industry to it by guiding its various stakeholders.”*

ALEXANDRA LEBERT  
Director Strategic Area of Research



### CIRCULAR ECONOMY AND BUILDING RESOURCES

*“Optimizing the use of our resources is essential to ensure sustainability of use and preserve the environment. This includes the development of reuse, the extension of useful lives and the use of secondary raw materials.”*

ALEXANDRA LEBERT  
Director Strategic Area of Research



See the  
**VISION 2030 SCIENTIFIC  
AND TECHNICAL ROADMAPS**



